

Maritime Geothermal Ltd.

NORDIC® models EMW-45-55-65

Installation Manual

Revision 4.0

Liquid-to-Water EMW Heat Pumps Designed for Radiant Floor Heating

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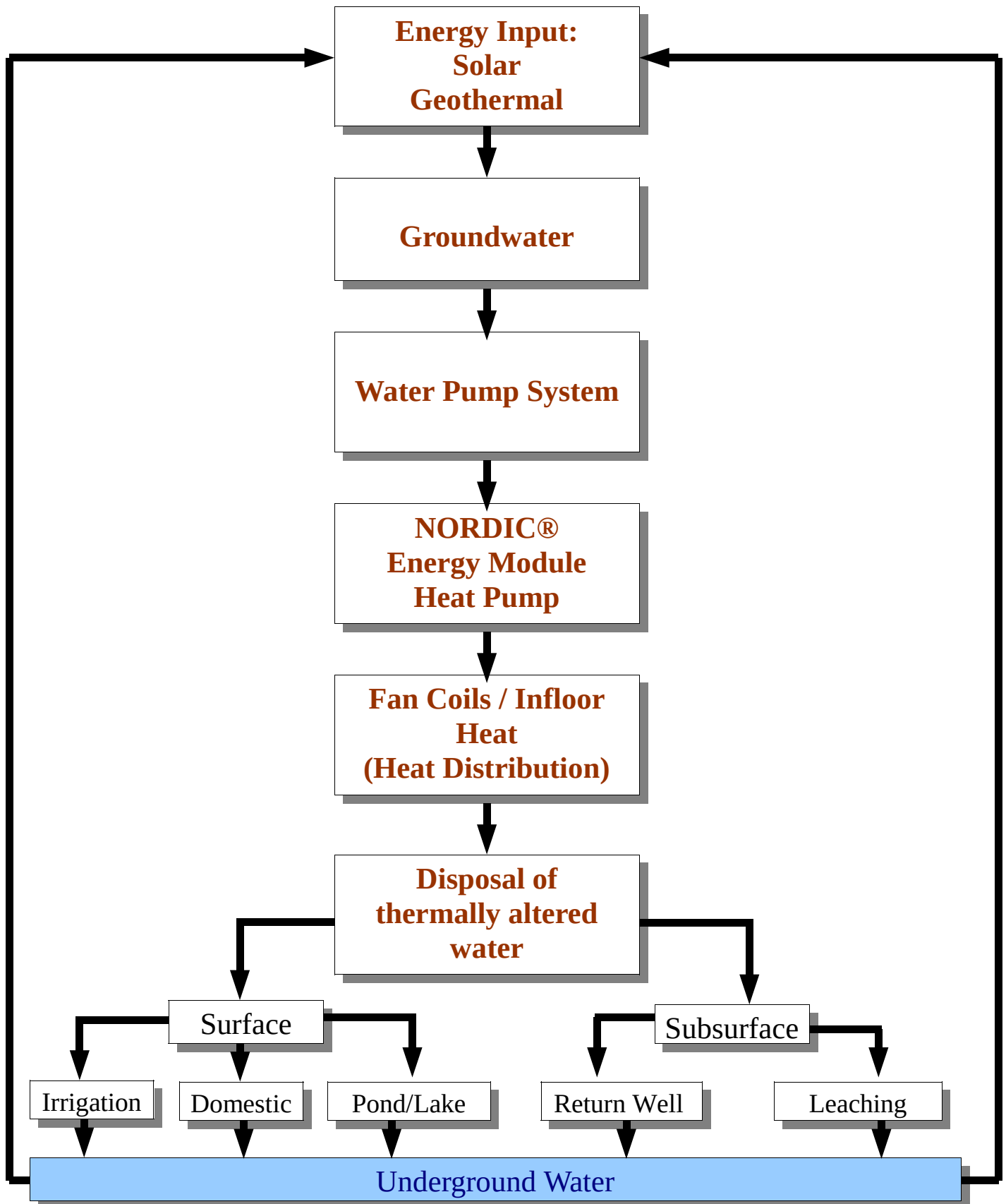
Water Well or Groundloop Operation

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Water Well Energy Module Heat Pump System



NORDIC® EM Water Well System Prerequisites

There are five specific parts or sub-systems to a groundwater heat pump installation:

The source of energy (groundwater)	Water Well
The method of supplying energy to the heat pump	Water Pump System
Converting the energy to a useable form	Heat Pump
Distributing the heat	Infloor Heat / Fan Coil Units
Returning the exhaust water to the earth for reheating	Water disposal

Water Well Requirements

1. A DRILLED well of 5" diameter or larger.
2. Well casing properly sealed or grouted into rock.
3. Water flow preferably entering well at a depth of 75 ft. or more.
4. Temperature of well at least 40° F. (Normally 45+ °F.)
5. Well must be able to supply requirements of BOTH heat pump and residence usage at the same time with maximum drawdown from static level of 30 ft.

Water Requirements For Nordic® Heat Pumps

Model	Heat Pump	Home	Total
Nordic EMW-45	7 Igpm	3	11
Nordic EMW-55	10 Igpm	3	13
Nordic EMW-65	12 Igpm	3	15

Note: These are minimum water requirements based on an entering water temperature of 46° F.
Igpm = Imperial gallons per min.

Water Pump System

1. A submersible pump is generally required. Must be able to pump the required water flow listed above at a minimum of 30 psig. at the dynamic pumping depth of your well.
2. Make sure you select the pump using the pump manufacturers pump chart.
3. Use a minimum of 30 gal. equivalent air bladder tank.
4. Make sure the pump will be able to pump the required flow for the heat pump while maintaining 40 psig. on the water lines for usage in the rest of the home.

The Heat Pump

A heat pump with Btu output capable of heating the home in all winter weather conditions should be selected using a "rule of thumb" as follows:

Model	Sq. Ft of Home*
Nordic EMW-45	1800
Nordic EMW-55	2700
Nordic EMW-65	3500
NOTE: Rule of thumb, use proper heat load software to determine exact requirements	

Maritime Geothermal Ltd. recommends that anyone considering the installation of a heat pump in their home or office have a professional heat loss / load calculation prepared on the building to determine the heating and cooling requirements. The correct sizing of the heat pump to the home can only be properly accomplished with the use of specialized software programs designed for this job.

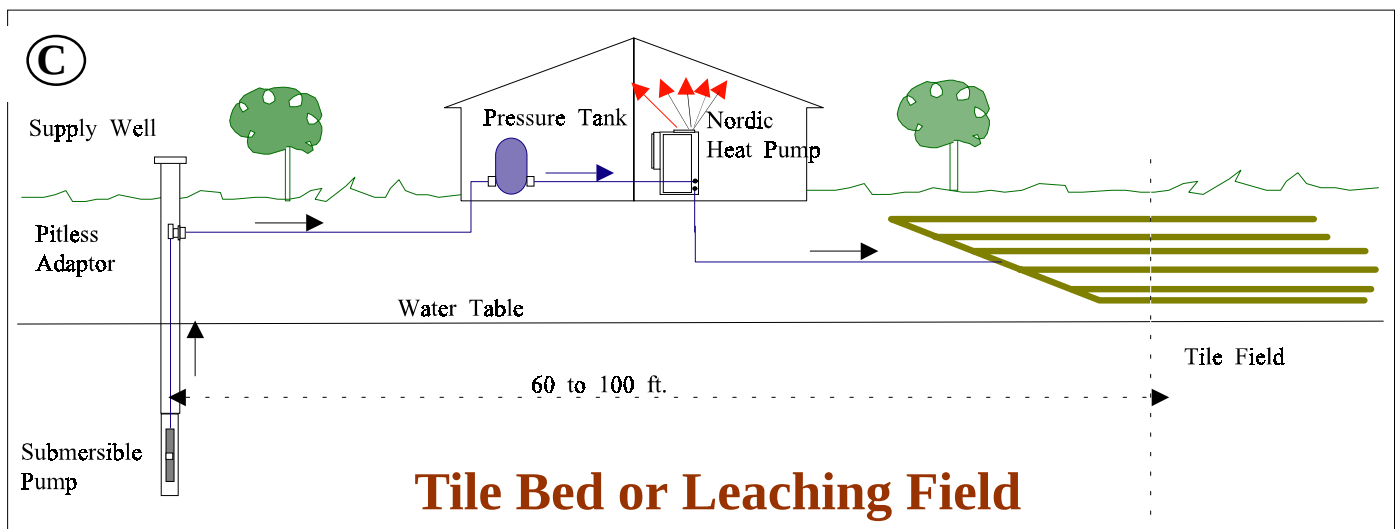
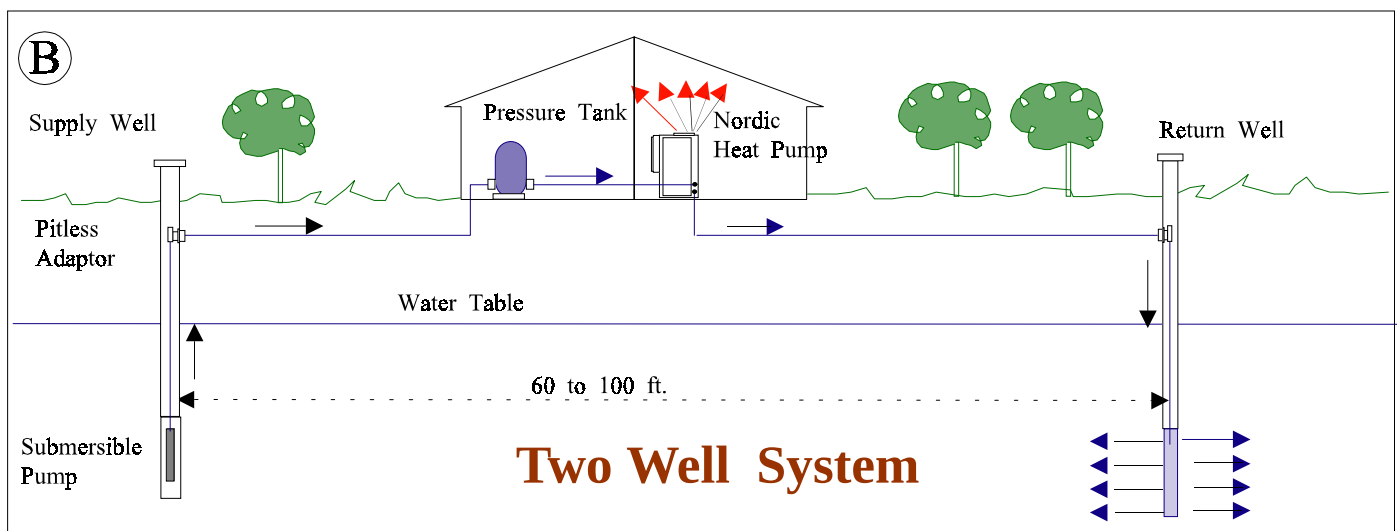
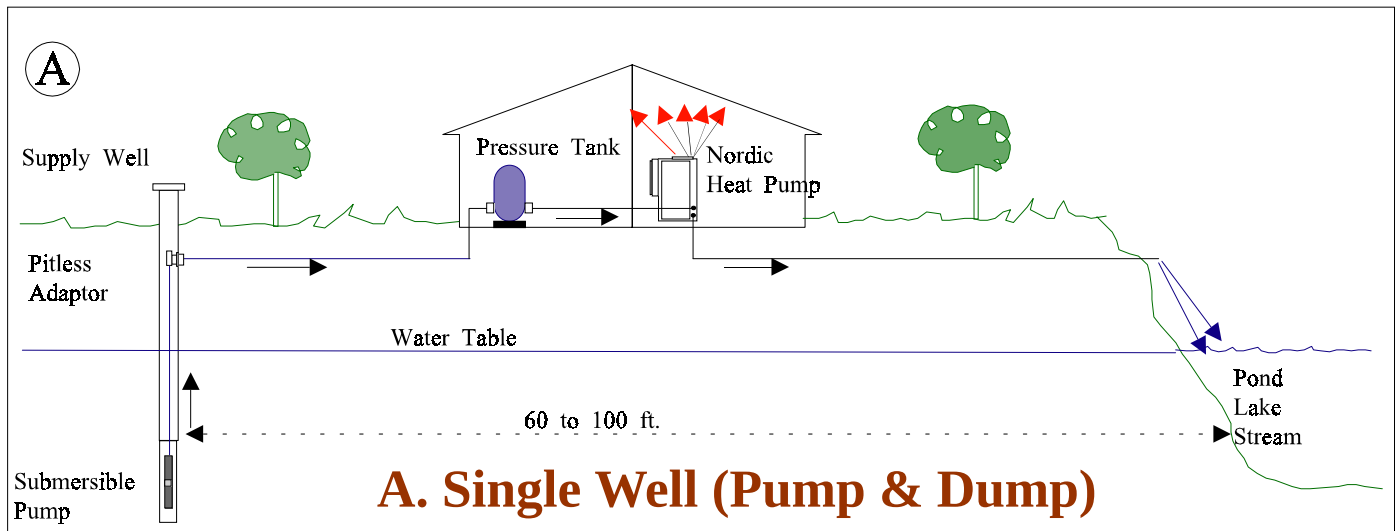
Discharge Water Methods

1. Although we highly recommend it, you do NOT necessarily have to have a return well.
2. Some of our customers do one of the following with their return or waste water:
 - A. Run it into a drain or ditch.
 - B. Pond, river or stream.
 - C. Leaching field.

In most instances if you run the water right out on top of the ground it will soak back into the ground in less than 50 ft. of travel. If suitable care is taken to insure that the drain pipe runs downhill and the end of the pipe is protected by a bale of hay or spruce bows etc. the end of the pipe will not freeze. When snow comes it will usually cover the entire process much like a small spring.

The above information is intended to give the prospective user/purchaser some insight as to the general requirements for a successful application of the NORDIC® heat pump.

NORDIC® EMW Series - Open Loop Disposal Methods



Unpacking

When the heat pump reaches its destination it should be unpacked to determine if any damage has occurred during shipment. Any visible damage should be noted on the carrier's freight bill and a suitable claim filed at once.

The heat pump is well constructed and every effort has been made to insure that it will arrive intact, however it is in the customer's best interest to examine the unit thoroughly when it arrives.

Placement

The location of liquid-to water heat pump inside the home should be determined by:

1. The ease at which piping runs can be connected to the in-floor heating headers on the output side of the unit.
2. Space availability in a mechanical room for the heat pump and associated piping.
3. Ease of access to the water well supply and discharge lines or groundloop lines.

If possible the six main service doors should remain clear of obstruction for a distance of (2) two ft. so that servicing and general maintenance can be carried out with a minimum of difficulty. Raising the heat pump off the floor a few inches is generally a good practice since this will prevent unnecessary corrosion of the bottom panel of the unit.

We recommend that the heat pump be placed on a piece of 2" Styrofoam covered with 1/4" plywood. The Styrofoam will smooth out any irregularities in the cement floor while the plywood will distribute the weight of the NORDIC® unit evenly over the Styrofoam. This process will also deaden the compressor noise emitted from the bottom of the cabinet.

As an alternative, several pieces of 2"x 4" lumber can be placed under the unit running from the electrical connection side to the opposite side of the heat pump. Laying the 2"x 4"s in this manner will give the best support since they will be at right angles with the internal steel compressor and heat exchanger support.

Plumbing the Heat Pump (water well application)

When installed on a water well, the NORDIC® heat pump must be supplied with an adequate water supply, since in essence, water is the fuel for the unit. It is imperative that the flow requirements listed in the engineering section be closely adhered to.

When setting up the unit, Maritime Geothermal Ltd. recommends the installation of a water flow meter on the discharge line so that the exact amount of water flowing can be determined at a glance. Once the correct flow of water has been established and determined to be consistent, the water flow meter could be removed from the line.

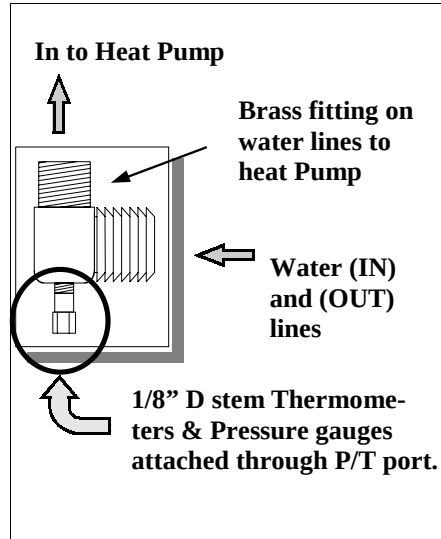
NOTE: Installing unions at each end of the meter and similar unions on a piece of pipe of the same length, allows the user to insert the meter in the line whenever the flow of water is to be checked and then remove the meter so that it does not deteriorate from day to day usage

Plumbing lines, both supply and discharge, must be of adequate size to handle the water flow necessary for the heat pump. For distances less than 40 ft. from the pressure tank, 3/4" copper or plastic lines should be run while for longer distances we recommend that 1" plastic or copper lines should be run to the heat exchanger. Similarly, a 1" line should be run from the discharge pipe to the

method of disposal.

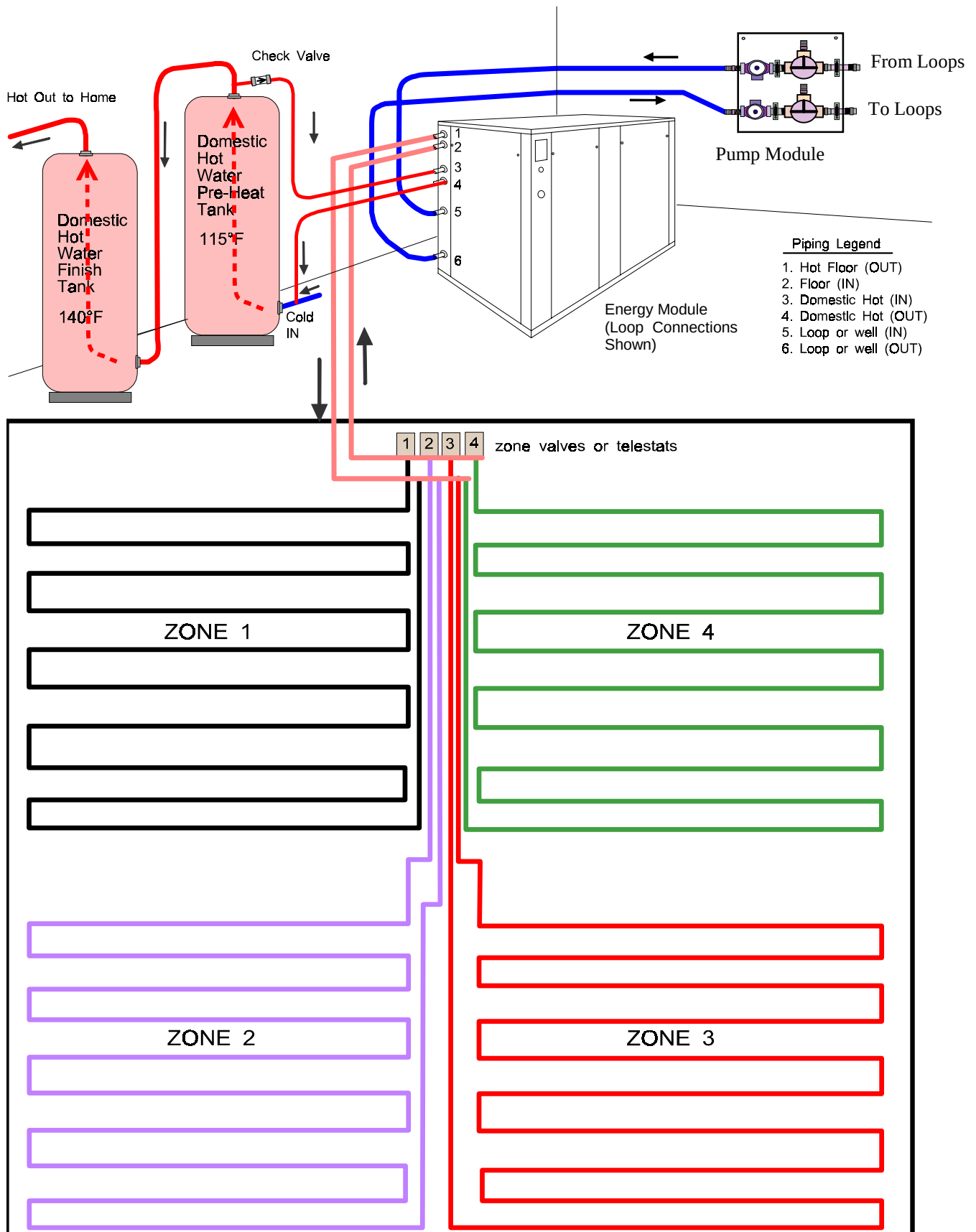
Install a P/T (Pete's Plug) plug on the Water (IN) and Water (OUT) lines just outside the heat pump so that it is easy to record the water in and out temperatures and pressures accurately.

Ideally there will be water flow available in excess of the requirement of the heat pump. In such a situation the proper pump can be selected to **maintain a pressure of 30 to 40 psig. on the lines when the heat pump is operating.** However in some cases a well can supply a heat pump only if the



Fittings and accessories available for P/T plug application to heat pump.

NORDIC® EMW – Closed Loop Connections



minimum requirement for water is used.

Supply water flow to the heat pump can be controlled very accurately by the installation of a reverse action pressure valve in the supply water discharge line of the unit. If the unit is a heating / cooling unit then a dual high pressure / low pressure valve or a pair of valves must be installed.

Another method of regulating the flow is by the use of a "DOLE" valve. This valve will automatically control the amount of water flowing through it by varying the diameter of a flexible rubber orifice through which the water passes. If either of such valves is needed they can be supplied and installed by your dealer.

All water line valves on both the supply and discharge lines should be either BALL or GATE valves since a GLOBE valve will create too much restriction across the line possibly causing the heat pump to trip out on its low pressure safety cutout control as a result of insufficient water flow.

Exposed water lines will have a tendency to sweat when the heat pump is in operation, therefore it is recommended that both the water supply and discharge lines be insulated with suitable insulation.

Hot Water Connections

Connection to the hot water generator feature of the heat pump is accomplished by teeing into an electric or oil fired hot water tank with a capacity of 40 gal. minimum. A typical piping diagram is shown on page 6 in this manual. Be sure to note the position of the check valve and the direction of water flow.

One should be sure the tank is filled with water and is under pressure before activating the heat pump. Slightly loosen the copper union on the hot water discharge pipe to allow air to escape from the system before the unit is started. This step will make certain that the water circulator is flooded with water when it is started.

Since the pump is water lubricated, damage will occur to the pump if it is run dry for even a short period.

The union on the discharge water line may have to be purged of air several times before good circulation is obtained. A hand placed several feet down the line will sense when the water is flowing.

The thermostats on the domestic hot water tank should be set to 100°F. since the heat pump has an internal thermostat set at a high of 115°F. By setting the tank thermostats as described, the heat pump will try to keep the tank above the cut-in point of the electric element settings thus generating hot water from the heat pump only. During periods of high demand, the electric elements may energize to help make hot water.

NOTE: If (2) shut-off valves are located on the hot water lines, be sure that the valves are open when the heat pump is operating. If both valves are closed when the heat pump is operating, water will expand in the hot water heat exchanger and could cause damage to the hot water circulator pump.

Water Disposal Methods

Water disposal methods vary from area to area however some consideration should be made to prevent the cooled discharge water from immediately coming in contact with the supply source. **Generally speaking, returning water to a second well, pond lake or stream is acceptable while returning water to the same well will usually cool the water so much that the heat pump will shut off on its low pressure / temperature safety control.**

A return well should be a minimum of 80 ft. from the supply well for residential applications. The water returned to the well will not be necessarily be pumped into the same aquifer, depending on underground conditions, but the return well does have to be able to supply the same quantity of water as the amount you wish to recharge into it.

If the static level (level when not being pumped) of a well is high (10 to 20 ft. from the surface) it may be necessary to place a **watertight** well cap on the well to keep the return water from flowing out the top of the well. This cap is commonly required since a certain amount of pressure is needed to force the return water back down the well if the static level is high.

Return wells are not always the answer and to some it may be more satisfactory to pump the water to a pond or away into the woods.

Water recharged naturally through percolation into the soil is an alternative to a recharge well. The water discharged will generally soak into the ground within a distance of 50 to 100 ft. If care is taken to make sure the end of the pipe does not freeze then this method of disposal works well.

Safety Controls

The NORDIC EMW series heat pump has two built-in safety controls which are designed to protect the unit from situations which could damage it.

A. LOW REFRIGERANT PRESSURE (heating mode)

The low refrigerant pressure control is designed to shut the unit down if the refrigerant evaporating pressure becomes too low thus risking the danger of freezing conditions in the evaporator.

There are only (4) reasons why this control would activate and they are:

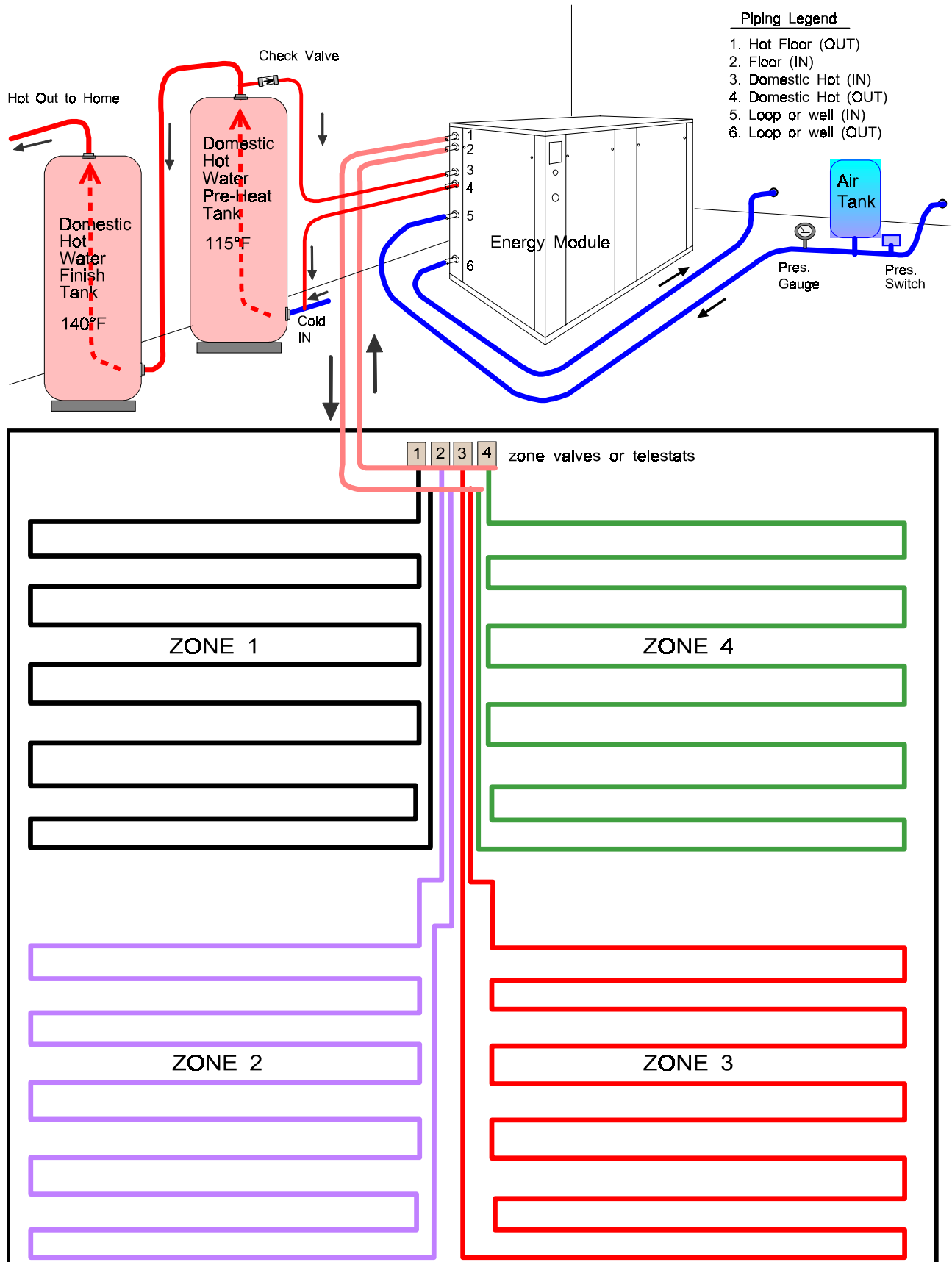
1. Low water flow. (See requirements for each model)
2. Low water temperature. (Below 40 °F.)
3. Dirty or fouled heat exchanger.
4. Low refrigerant charge.

B. HIGH PRESSURE CONTROL

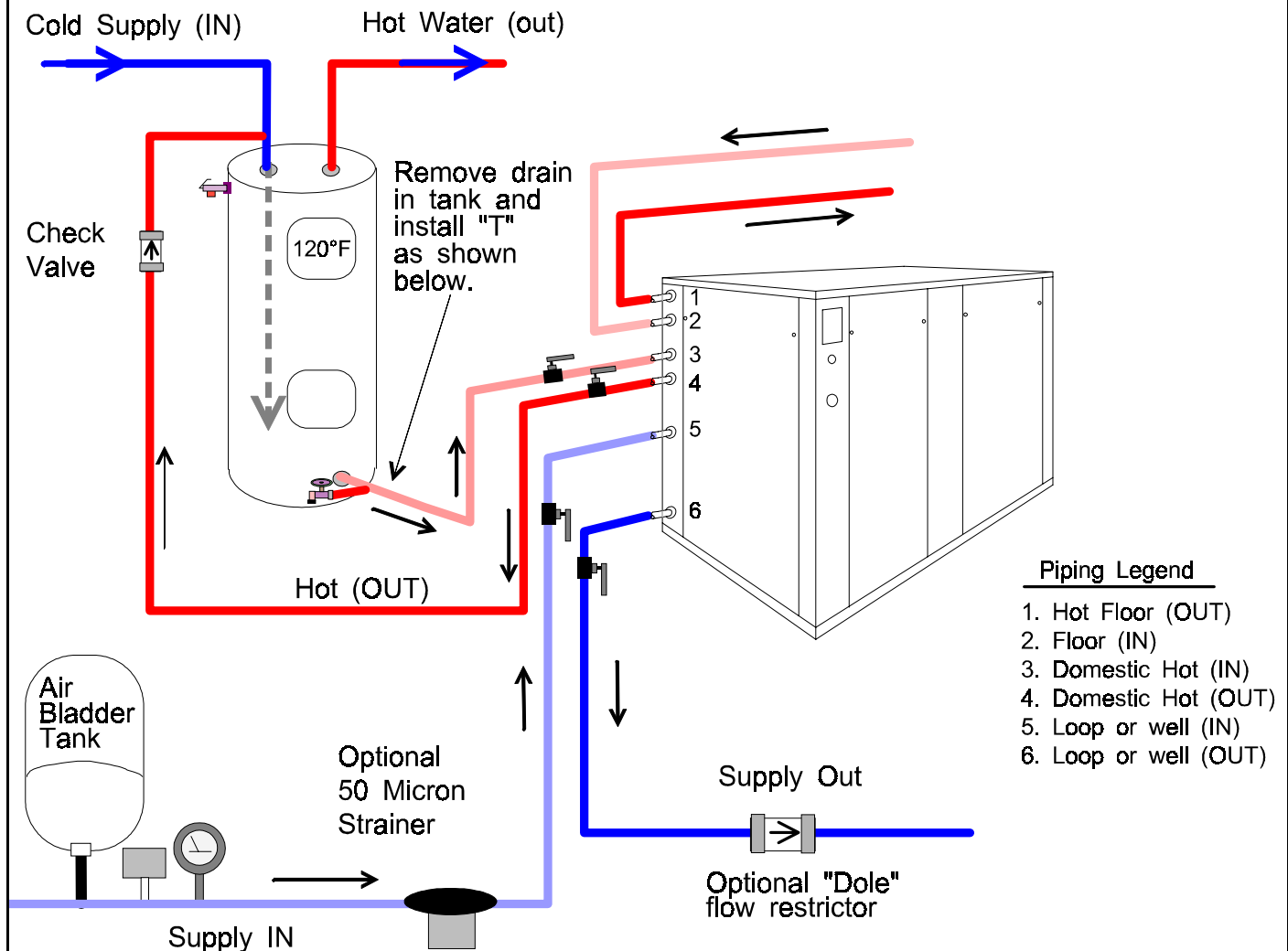
The second safety control is a high pressure safety limit which monitors compressor discharge pressure. This device will not normally trip unless the water level is low in the internal storage tank. Such a situation could occur if the tank was drained for service and not refilled or the aquastat setting was set above 120° F.

If one of these controls trips it will activate a

NORDIC® EMW– Well Water Connections



EMW – Hot Water tank Plumbing (Alternate)



The drawing above describes how to plum a single domestic hot water tank to an Energy Module. However this technique will only allow the hot water to reach the same temperature setting as the EM internal tank.

LOCK-OUT RELAY which prevents the unit from restarting until the electrical supply to the unit is broken by opening the heat pump breaker and then closing it again. If one of these controls trips there is a serious problem with the system and it must be rectified if the unit is to maintain good service.

NOTE: Under no circumstances should the heat pump lock-out relay be reset more than twice in an hour. If the heat pump is shutting off because of LOW or NO water flow on the cold side then repeated resetting of the unit could cause the heat exchanger to freeze and rupture – destroying the heat pump.

inside the electrical box cover for quick reference and although the connections to be made are quite simple, Maritime Geothermal Ltd. recommends that a properly qualified electrician be retained to make the connections and wire the thermostat.

The NORDIC® EM unit has its own digital thermostat which controls both the heat pump first stage and the electric heat second stage. Settings are described on page 26 of this manual.

Electrical Connections

The NORDIC unit is supplied with an opening for 3/4" conduit nipple on the right side of the unit. Above this is another 3/8" hole for the thermostat wire. A wiring diagram is located

Starting the Heat Pump

BEFORE starting the heat pump the following areas should be rechecked to assure proper operation.

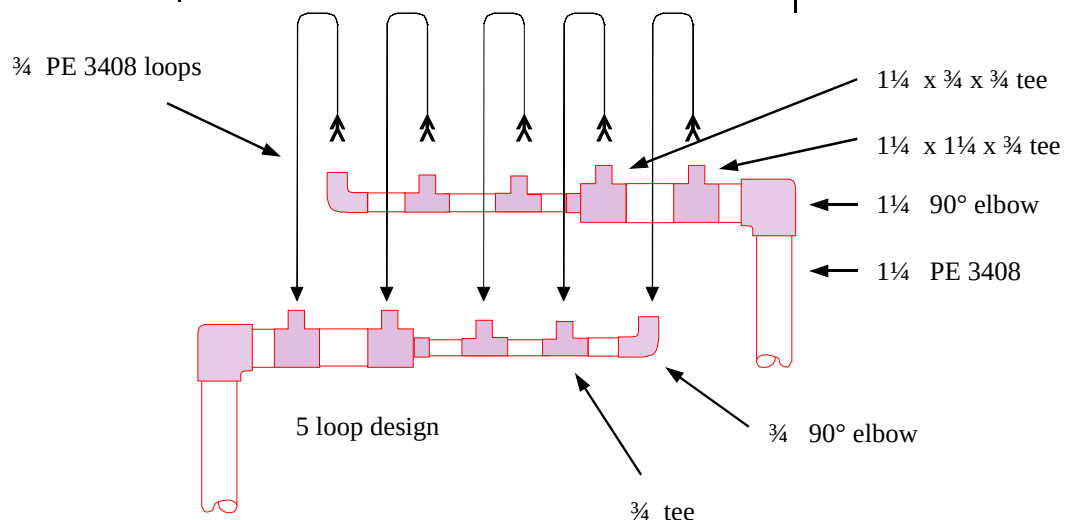
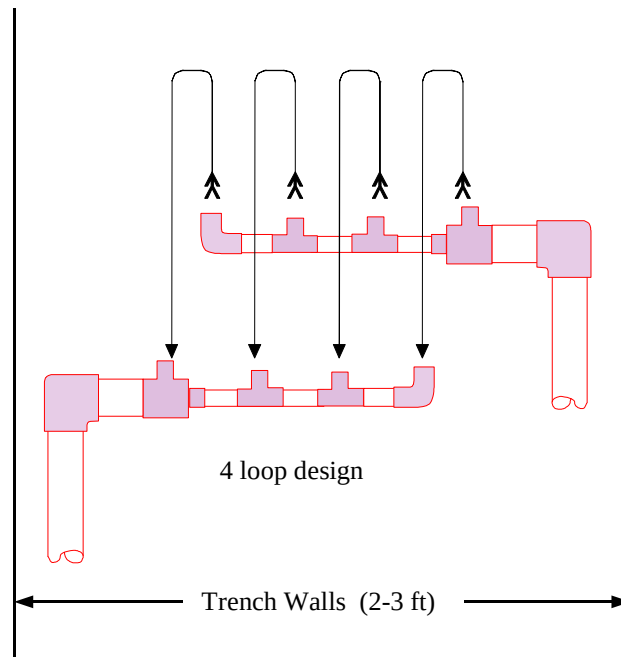
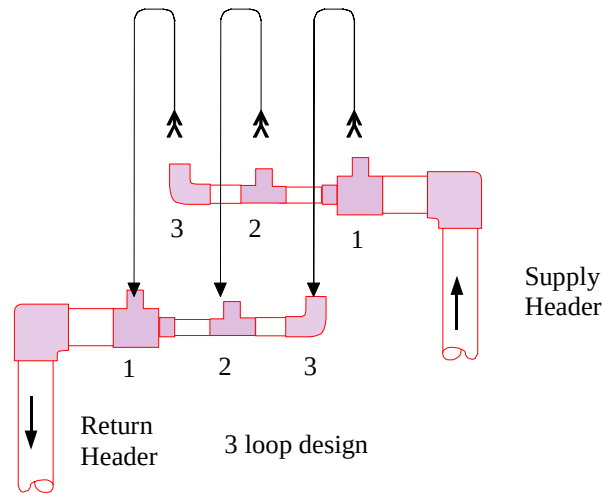
1. Check all high voltage field wiring and electrical connec-

3 – 4– and 5 Loop Closed Loop Header Designs

Typical reverse return 3 ton (3 loop) header shown at right.

In a Reverse return header system the first line out on the supply header is the last line back on the return header.

A reverse return header automatically balances the flow in each loop as long as the loops are the same length and diameter.



tions inside the control box for good connection.

2. Check all low voltage thermostat to make sure they are connected properly.
3. Turn on the main power switch. Allow the power to remain ON without starting the unit for a period of 4 hours. Refrigerant migrates to the compressor oil when the compressor is unheated. On most units a crankcase heater is standard equipment on your heat pump and it will warm the compressor, dispelling the liquid refrigerant. Compressor damage can occur if the heat pump has been brought in from a cold location and immediately started up.
4. Turn on the water supply and check all plumbing for leaks.
5. Check the domestic hot water tank to be sure it is filled with water before energizing the circuit.
On systems equipped with ball valves on the domestic hot water lines, both valves must be in the open position. Never shut off both valves when the heat pump is operational, since water expanding in the hot water generator loop may cause damage to the circulator pump housing. Slightly open the union on the hot water discharge pipes to make sure that all air is out of the system and the circulator pump is flooded with water.
6. Make sure all pumps are wired, purged of air and ready to pump water.
7. Vacuum out any dust and debris that may have collected in the unit during installation.
8. Make sure the unit is sitting level.
9. Make sure the proper time-delay fuse or breaker has been installed in the electrical box.
10. Have the following tools on hand and know how to use them.
 - A refrigeration gauge set.
 - An electronic or other accurate thermometer
 - An amprobe.
 - A water flow meter.
11. Connect your refrigeration gauge set.
12. Turn on the main power switch. The compressor should start and water will begin to be heated in the storage tank.
NOTE: If the unit is equipped with an electric TACO water valve the valve will open in 30 to 60 seconds followed by the compressor. When the TACO water valve is fully open, an internal switch activates the compressor circuit.
You can observe the rise of temperature in the tank via the Ranco® aquastat digital output display. If the electric backup element breakers are energized and the water is below 95°F, the electric elements will also be ON with factory aquastat settings.

13. Observe the readings on the high and low pressure gauge set. With entering water temperature of 45° to 50°F, the suction pressure (blue gauge) should be approximately 53 to 58 psig. while the head or discharge pressure (red gauge) should be in the area of 225 to 300 psig. Depending on the temperature of the water in the tank. Record this information on the warranty test card.

14. Using an electronic thermometer or other accurate thermometer, record the supply water temp. "IN" and the water temperature "OUT".

The outlet water temperature should be from 4° to 7° F. cooler than the inlet water temperature.

15. Record the supply water flow in gpm.

16. Record the time required to heat the tank up to temperature.

17. Record the voltage at the terminal blocks with a digital voltmeter.

18. At the electrical disconnect switch place the amprobe jaws around the supply wires and record the current in each.

General Maintenance

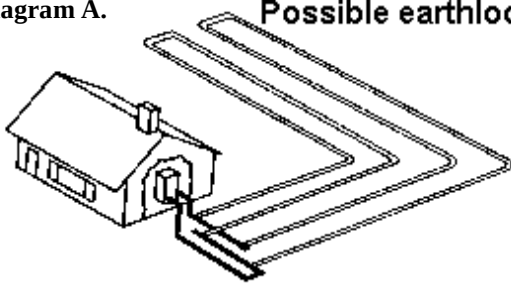
As with any piece of equipment there will eventually be some maintenance to be done on the heat pump.

NORDIC® water and loop based heat pumps are equipped with coaxial type heat exchangers. These heat exchangers are not manually cleanable however they can be cleaned with a sulfamic acid solution commonly marketed under the trade name "**Iron-Out**". If you suspect that the supply water being pumped through the unit is of a poor quality or you notice a decrease in performance after several years of use it may be necessary to have the liquid heat exchanger cleaned.

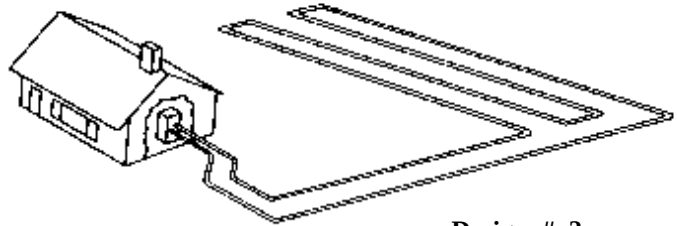
Maritime Geothermal recommends that a qualified serviceman be retained to carry out this procedure since the solution involved is highly corrosive.

The hot side of the heat pump requires no maintenance.

Diagram A. Possible earthloop configurations - Type 3408 High Density PE tubing



Design # 1



Design # 2

Parallel piping - Reverse Return Header System

Series piping - 1 or 2 pipes per trench.

Diagram A.

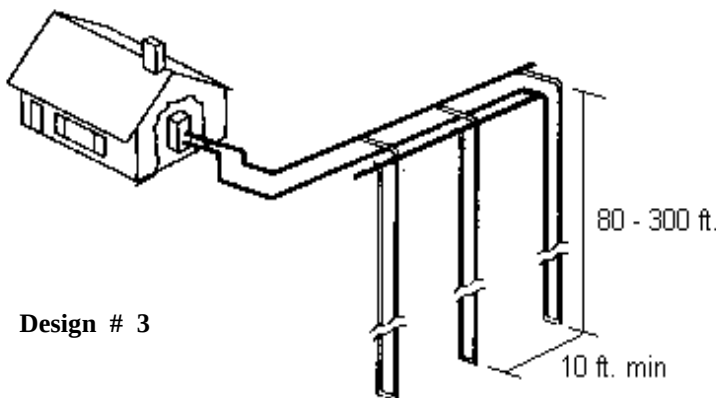
Shown above are several of the many possible horizontal loop layouts which have been successfully employed in various types of ground conditions.

Design # 1

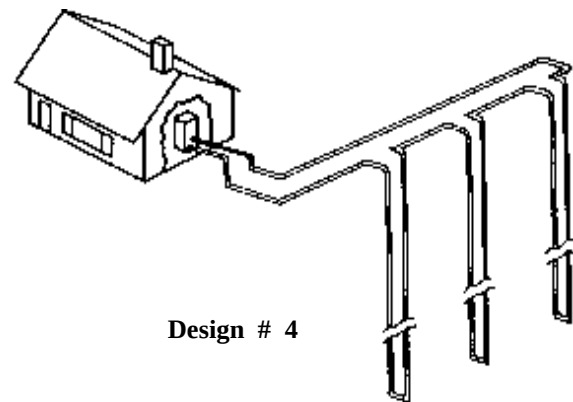
Shown is a typical reverse return header system and 2 parallel loops. On a 2 ton system each of these loops would be 500 ft. long with 4 ft. spacing between the **"U" sections**, 10 ft spacing between the **loops** and buried 6 ft. underground.

Design # 2 is a single loop of 1-1/4" to 1-1/2" diameter pipe with a length of 500 ft. x the tonnage of the system and buried to a depth of 6 ft. underground. Individual runs of pipe should be kept a minimum of 10 ft. apart.

Diagram B.



Design # 3



Design # 4

Vertical - Parallel

Vertical - Series

Design # 3.

Shown is a vertical borehole reverse-return header system. Vertical systems generally require 125 to 175 ft of borehole per ton of heat pump for successful heat transfer to take place with the earth. Boreholes should be spaced a minimum of 10 ft apart while if land is available, 15 ft. spacing will produce better results.

Boreholes should be tremie grouted from bottom to top with bentonite or a mixture of bentonite and neat cement for proper conduction with the earth.

Design # 4.

Shown here is a typical series loop design using 1-1/4 to 1-1/2" pipe for the loops. Some designs incorporate a double "U" tube assembly down the well which allows for better heat transfer between the earth and the loop.

NOTE

Many other loop designs are in common use throughout North America. For a more comprehensive manual on earthloop design refer to our Earthloop Design Manual or contact IGSHPA (International Ground Source Heat Pump Association) and request their earth systems dealer training manual.

EMW- Series Closed Loop Installation Information

Introduction

Many commercial buildings select a vertical or horizontal closed loop as the earth heat exchanger either because of a lack of available groundwater or for the reduced maintenance costs which can be obtained when compared to open loop systems. Often the problems which occur in a geothermal system are associated with the wells, pumps, or the direct result of utilizing poor quality water or water which is contaminated with sand or other foreign materials. Such contamination can cause premature failure with pumps, water valves, heat exchangers and return wells.

To reduce these problems to a minimum a closed secondary heat exchange system is constructed with **Type 3408 Polyethylene Plastic Pipe** specifically engineered for the job. Materials such as PVC and polybutylene are not recommended since their underground joining process is not as reliable as the fusion process used with type 3408 polyethylene. The earthloop heat exchanger can consist of a single long length of plastic commonly called a **series** style heat exchanger or more commonly is found as a number of **parallel** loops connected to a **reverse return header system**. The series system for homes or light commercial applications up to 10 tons normally is constructed with 1-1/4" to 2" diameter pipe while the parallel system uses multiple branch loops from 3/4" to 1" connected to a larger header pipe system of 1-1/4" to 2" diameter. The parallel system offers several advantages such as:

- Less expensive pipe.
- Easier to handle the smaller pipe.
- Lower pressure drop
- Smaller circulator pump(s)

Of course on larger commercial systems it would not be unusual to find header systems with up to 6" diameter pipe for fluid flow into and out of the building.

Socket Fusion

Mechanical joints or metal fittings of any kind are not acceptable underground in an earth loop system due to large temperature fluctuations which may loosen and break clamps and the possibility of eventual corrosion perforation in couplings and "T's".

Fittings and joints are socket or butt fused together into one contiguous unit using a technique developed by the gas industry. A heater tool with the appropriate faces heats both the pipe and fitting for a prescribed period of time and then the two pieces are quickly removed from the heater, inserted together and held in place until the joint cools. When properly done the resulting joint is stronger than the original pipe with no chance of leaks or breaks. For more information on butt and socket fusion techniques see our website at ([http://www.](http://www.discribe.ca/nordic/fusion.htm)

[discribe.ca/nordic/fusion.htm](http://www.discribe.ca/nordic/fusion.htm)) or request a copy of the Central Tools Butt and Socket fusion manual.

Horizontal Groundloops

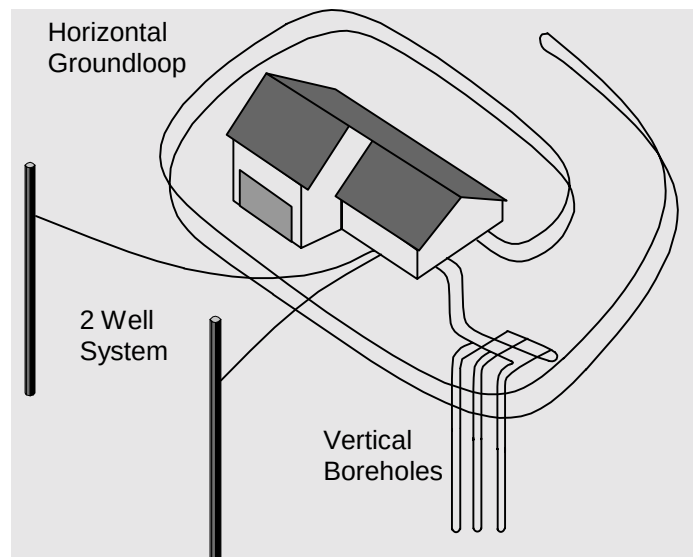
Horizontal groundloop systems are most commonly used where land is readily available since they are cheaper to construct than their vertical counterparts. Although many configurations are available, we have found that a parallel system with one (1) 500 ft. "U" pipe per ton placed in a 250 ft. x 4 ft. wide x 6 ft. deep trench is easy to construct and provides ample ground impact area to adequately supply a 32°F or better Entering Fluid Temperature to the heat pump even in the most severe winter months. (See opposite Diagram A.)

Several companies including **"Thermalworks"** and the International Ground Source Heat Pump Association (igshpa) provide modeling software to size the heat pump to the home and then size the loop to the demand of the home and heat pump. Consideration is given to many factors such as type of ground, moisture content and configuration of loops desired. It is often possible to shorten loop lengths and resulting costs when using some of the newer **"Slinky"** designs of earth-loops. A comprehensive manual dedicated entirely to the installation of groundloops is available from Maritime Geothermal Ltd. which describes in detail the techniques involved in installing a closed loop system.

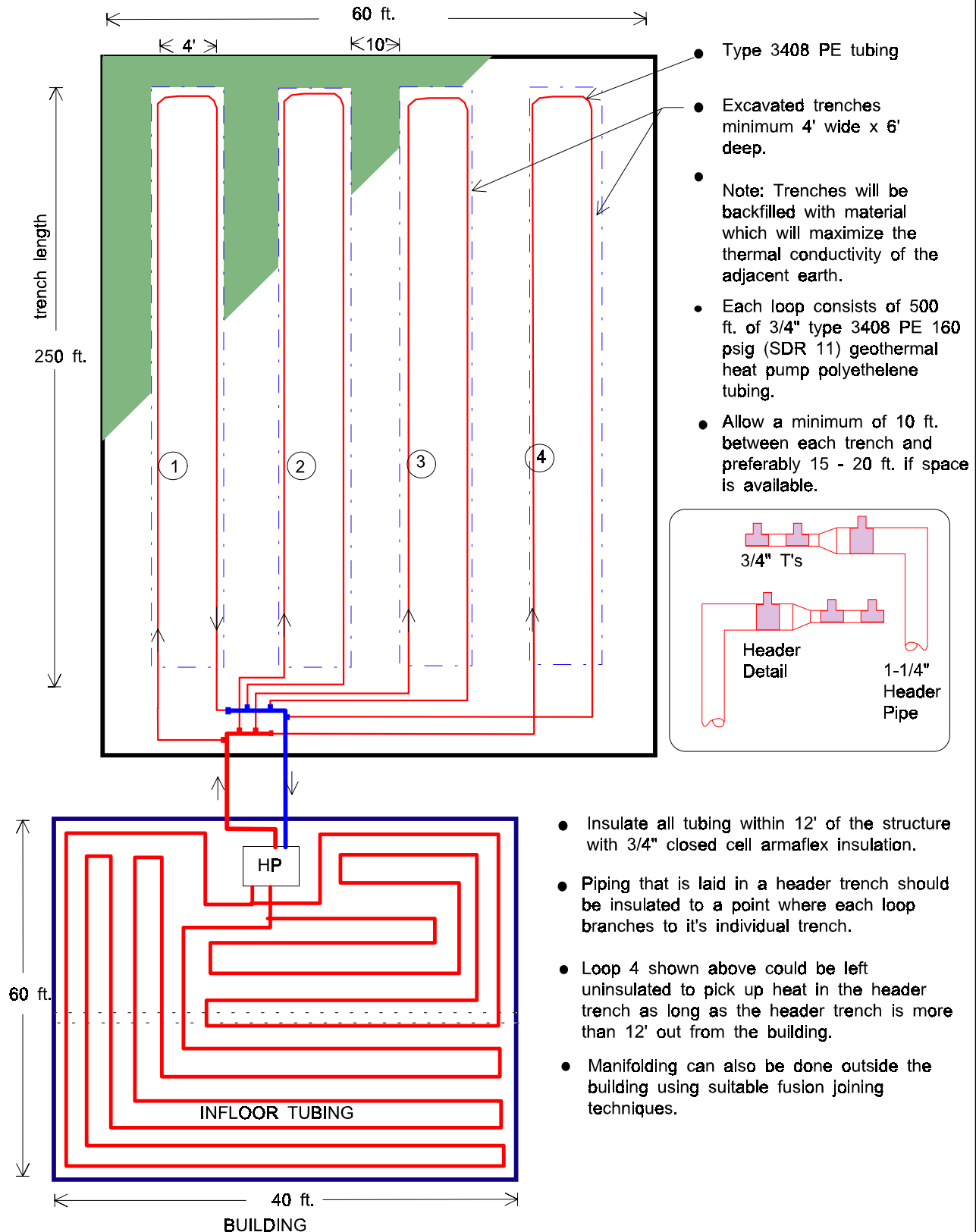
Vertical Groundloops

Vertical groundloop systems are generally the system of choice for commercial and institutional buildings since the land area available is often limited to parking lots with some adjacent landscaped areas.

Boreholes of 4 to 6 in. diameter are drilled with conventional drilling equipment usually to a depth of less than 300 ft.



One Example of Piping Layout for Horizontal Closed Loop Heat Pump System (4 ton system shown)



Each “ton” of heat pump installed requires approximately 150 ft. of borehole. The 3/4” to 1” plastic pipe “U” tubes are fused together using socket fusion techniques and then pressure tested for leaks at 100 psig. using either water or air. Provision should be made to allow enough extra pipe to extend from the boreholes to the proposed location of the header system. Prior to inserting down the hole the assembly must be filled with water so that buoyancy will be at a minimum when inserting the “U” tube. Cap the ends so that mud and

Table 1. Antifreeze Percentages by Volume

Protection down to:	10°F	15°F	20°F	25°F
Methanol	25%	21%	16%	10%
Propylene Glycol	38%	30%	22%	15%

debris cannot enter the loops during insertion and grouting. A piece of heavy rebar or galvanized pipe is attached to the bottom 10 to 15 ft of the “U” tube with tape to add weight to the assembly and also prevent it from curling up and gouging into the side of the borehole during insertion. The entire length of the assembly should be taped every 10 ft. to create greater rigidity in the “U” tube assembly as it is installed in the borehole. The “U” tube is inserted into the borehole along with the tremie pipe and the borehole is tremie grouted from bottom to within 10 ft. of the top with a mixture of neat cement and bentonite or 100% bentonite. When using bentonite refer to the manufacturers instructions for mixing and select a product that provides a total solids content of from 25 to 30% when mixed.

Horizontal trenches from 4 to 6 ft. deep are dug alongside the boreholes to the building so that a reverse return (first pipe out on the supply line is the last pipe back on the return line) header pipe arrangement can be constructed to tie all the loops together. Lay out the header system so that air cannot be easily trapped in the header using a technique approved by IGSPHA or the local governing authority. Use a shovel to break away any ground between the trench and the boreholes and dig a relief no less than 30 times the diameter of the pipe to allow the pipe to bend to the header pipe without kinking. Be very careful not to disturb the original ground under the relief so that you do not have to worry about the pipe being kinked through compaction of the earth under the pipe after the trench is backfilled. Fuse the individual smaller loops to the main header loops and extend these into the home by drilling through the concrete wall or by rising up the outside of the basement wall or slab and entering the structural part of the home or building above grade. Any piping that comes within 10 ft. of the structure should be insulated with 3/8” to 1/2” closed cell armaflex insulation to prevent freezing from occurring near any structural part of the building. Likewise, all piping inside the building must be insulated to prevent condensation and subsequent dripping onto floors or walls.

Circulator Pump Module

When the groundloop has been brought inside the home or building to the location of the heat pump it must be connected to the pump module which generally consists of (1)

Grundfoss® Model UPS 26-99 or Taco® Model 0011 pump for systems up to 3 ton and (2) pumps for systems up to 5 ton. These units must be able to pump at least 2.5 to 3 USgpm. per ton of heat pump for proper operation of the system. To calculate the size of pumps required use the pressure drop tables for the diameter and type of tubing used along with all elbows, T’s etc and the pressure drop through the unit’s heat exchanger to arrive at:

$$(\text{total ft of head}) \times (3 \text{ gpm/ton}) \times (\text{No. of tons})$$

Heat Pump to Circulator Piping

The heat pump must be connected to the circulator pump module with a lineset suitable for the flow required with minimum pressure drop. Common line sizes would be 3/4” rubber or plastic for heat pumps from 1 to 2.5 ton while for unit sizes 3 through 5 ton, 1” lines should be used. The installation of P/T plugs (pressure / temperature) pronounced “Pete’s plugs” should be installed on both the entering and leaving lines at the heat pump. The P/T plug will allow the installer or homeowner to check water flow through the loop by measuring the pressure difference through the heat exchanger and comparing this pressure drop to that of the appropriate model in the engineering section. (see **Pressure Drop vs. Water Flow Table**)

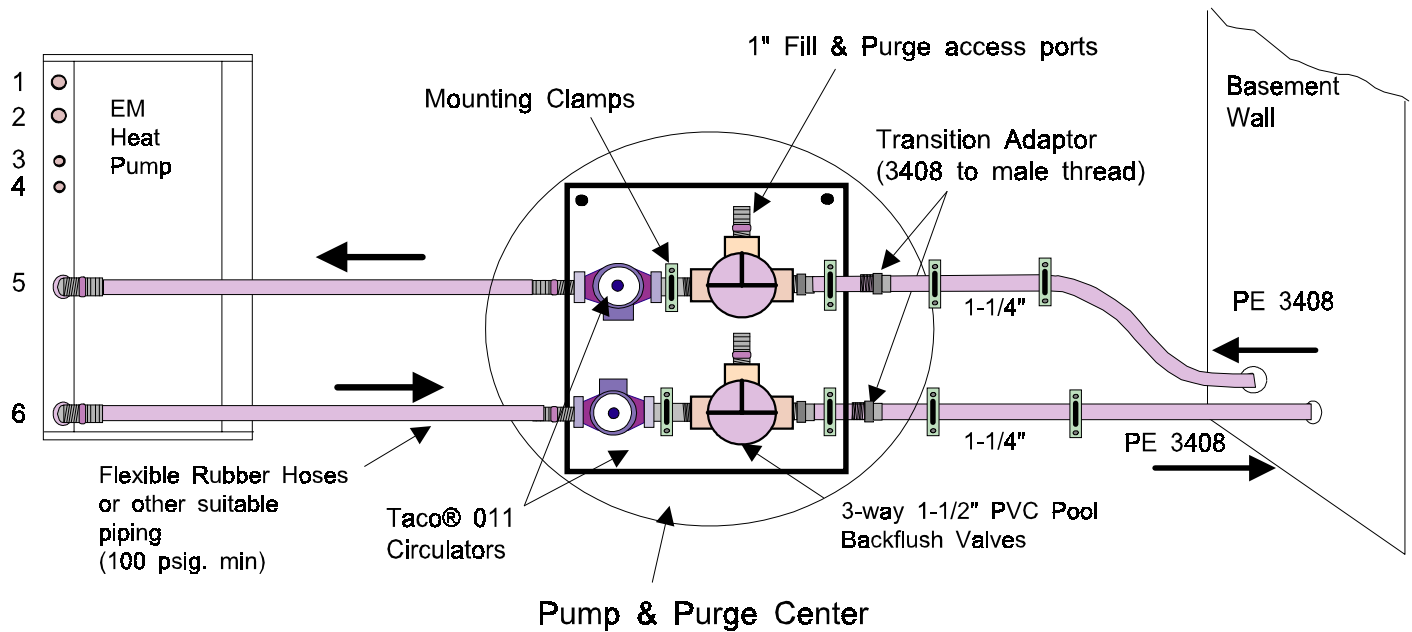
Table 2. US Gal. of fluid per 100 ft. of pipe

Type of Pipe	Diameter	Volume (US gal.)
Copper	1”	4.1
	1-1/4”	6.4
	1-1/2”	9.2
Rubber Hose	1”	3.9
Polyethylene	3/4” IPS SDR11	2.8
	1” IPS SDR11	4.5
	1-1/4” IPS SDR11	8.0
	1-1/2” IPS SDR11	10.9
	2” IPS SDR11	18.0
Heat Exchanger	Average	1.5
Flush Cart Tank	15”D x 3 ft. high	28

Flushing & Purging the Earthloop

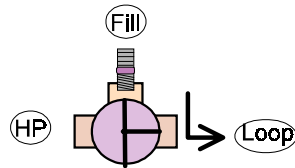
Once the earthloop has been installed and all connections are completed to the heat pump and pumping station the entire plumbing system should be pressure tested with air to 100 psig. to make sure there are no leaks on any of the inside fittings. Soap all joints and observe that the pressure remains constant for 1 hour.

Loop Pump Module Piping

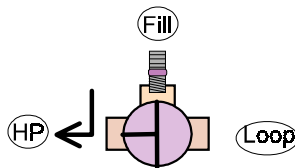


Pipe Connections

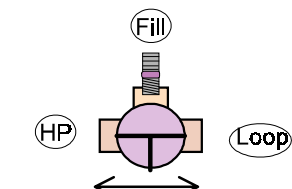
1. Floor Hot Out
2. Floor Hot IN
3. Hot Domestic IN
4. Hot Domestic OUT
5. Supply water IN
6. Supply water OUT



1. Valve in Loop fill/purge position.



2. Valve in HP fill/purge position



3. Valve in normal running position.

NOTE: If you use pressure gauges permanently installed on the system as in the case of a demonstration situation etc. be careful not to exceed the maximum pressure rating of the gauges to avoid damage to their mechanism.

When satisfied all connections are leak free, release the air pressure and connect a flush cart (see diagram) to the flushing access ports at the pump station. A temporary flushing system can alternately be constructed using a 45 gal. barrel and a pump with sufficient volume and head capability to circulate fluid at a velocity of at least 2 ft./min. through all parts of the loop. Begin pumping water through the earthloop making sure that the intake of the pump stays submerged at all times by continuously adding water from a hose etc. Water flowing back on the return line should be directed below the water level in the barrel or flush tank to prevent air being mixed with the outgoing water. Once the lines have been filled and no more air bubbles are appearing in the line, adjust the flow valves to circulate water through the heat pump using the same technique as described above. When all air is removed reverse the flow of water through the lines by interchanging the flush cart lines and purge again. You will be able to visibly tell when all air is removed.

Installing Antifreeze

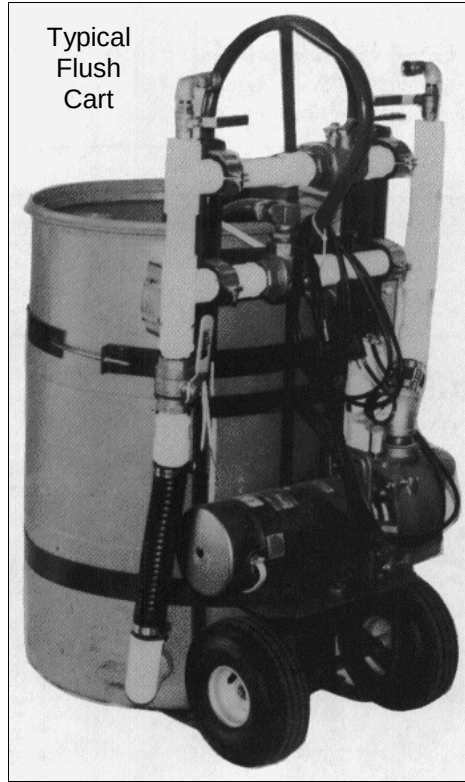
In most mid and northern areas of the US and in all of Canada it is necessary to condition the loop fluid by the addition of some type of antifreeze solution so that it will not freeze during operation in the winter months. This antifreeze is required because the loop fluid will normally reach a low entering temperature of 28°F to 32°F. and refrigerant temperatures inside the heat pump's heat exchanger may be as low as 20°F cooler. See the antifreeze concentration chart at left for details of freeze protection afforded under different concentrations.

NOTE: Add enough antifreeze to allow for a temperature 20°F lower than the expected lowest loop fluid temperature entering the heat pump.

NOTE: Although many different antifreeze solutions have been employed in geothermal systems, the alcohols such as methanol or ethanol have the most desirable characteristics for earthloop application. The overall heat transfer characteristics of these fluids remain high although care must be taken when handling pure alcohols since they are extremely flammable. Once mixed in a typical 25% by volume ratio with water the solution is not flammable. In situations where alcohols are not allowed as a loop fluid due to local regulations then propylene glycol is a non-toxic alternative which can be substituted. Propylene glycol should only be used in cases where alcohols are not permitted since the heat transfer characteris-

tics are less desirable and it becomes more viscous at low temperatures which increases pumping watts. The volume of fluid that your loop system holds can be closely estimated by totaling the number of ft. of each size pipe in the system and referencing **Table 2.** the for approximate volume per 100 ft.

When the volume of the loop has been calculated and the appropriate amount of antifreeze is ready for addition by referencing **Table 1.**, drain the equivalent amount of water from the flush cart or mixing barrel and replace it with the antifreeze. When using alcohols be sure to inject it below the water line to reduce initial volatility of the pure antifreeze. If the loop is large and the tank is small it may be necessary to refill the tank with antifreeze several times to get all the antifreeze into the loop. Pump the loop for 5 to 10 minutes longer to insure the remaining fluid has been well mixed.



Initial Pressurization

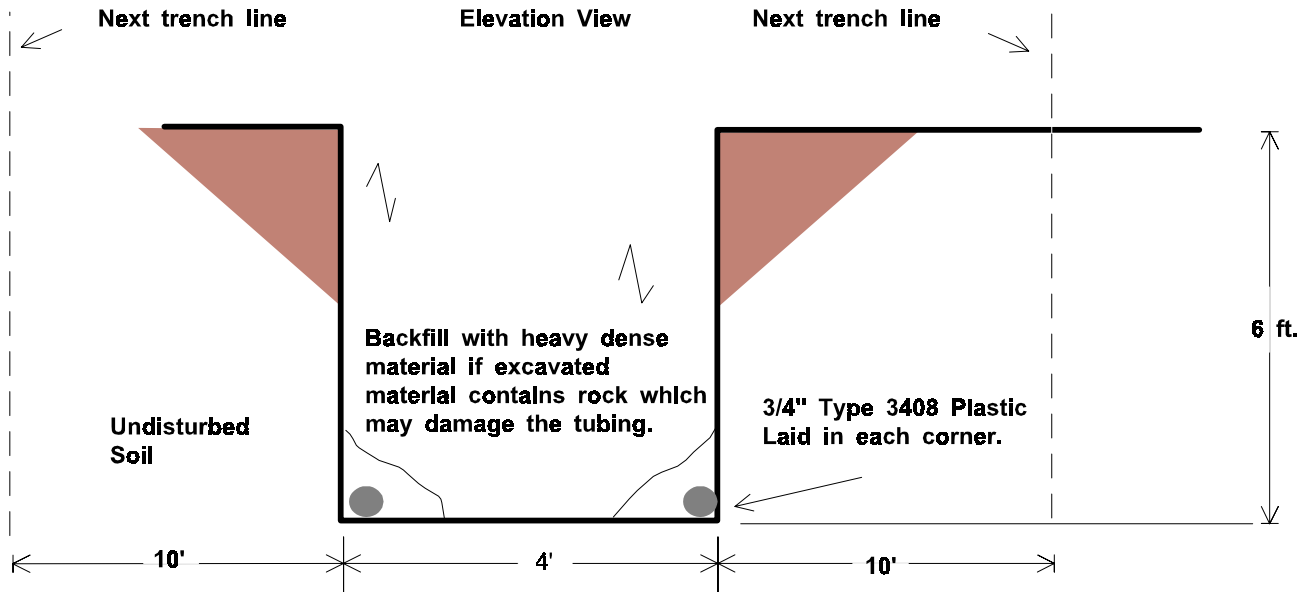
At this point open all valves in the flow circuit and slowly close off the supply and return flush cart valves in a manner that leaves about 20-30 psig. on the system. If an air bladder expansion tank is used the bladder should be charged to the above pressure before actual water pressure is put on the system. Systems employing a commercially available loop pump kit that do not have an ex-

pansion tank, thermometers and pressure gauges will experience a greater fluctuation of pressure in the loop between winter and summer. This fluctuation is normal since expansion and contraction of the loop fluid must be handled by the elasticity of the plastic loop. Pressurize the loop to a pressure of 45 psig. when installing a system in the fall going into the heating season. If installing in spring or summer charge to 25 psig.

After operating the machine for a period of time, any residual air in the system can be bled off through valved vertical standpipes in the pump module. If pressure drops below 25 psig. add additional water / antifreeze mix with the purge pump to bring the pressure back to the original setting.

NORDIC® Horizontal Trench Design

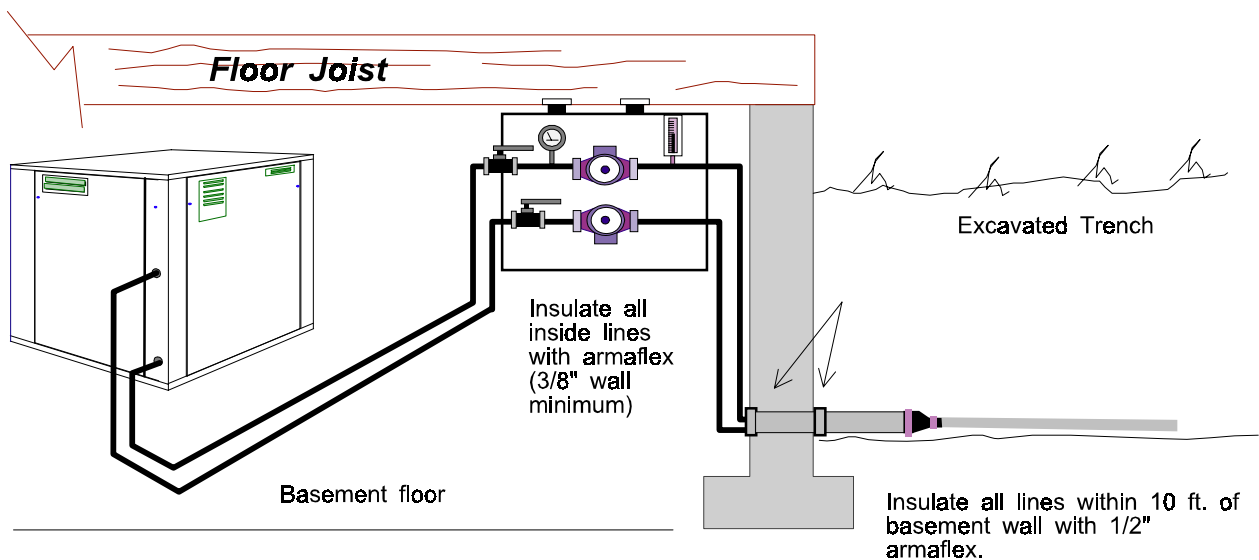
Closed loop Plastic Earthloop



IMPORTANT NOTES:

Horizontal style pipe runs should be placed 6' deep x minimum of 48" wide trench as shown above. Hand backfilling in the area just over the plastic is recommended to prevent crushing or pinching of the pipe during backfilling operations. Individual trenches (1 per ton) should be spaced a minimum of 10 ft. apart to allow the best performance of the groundfield.

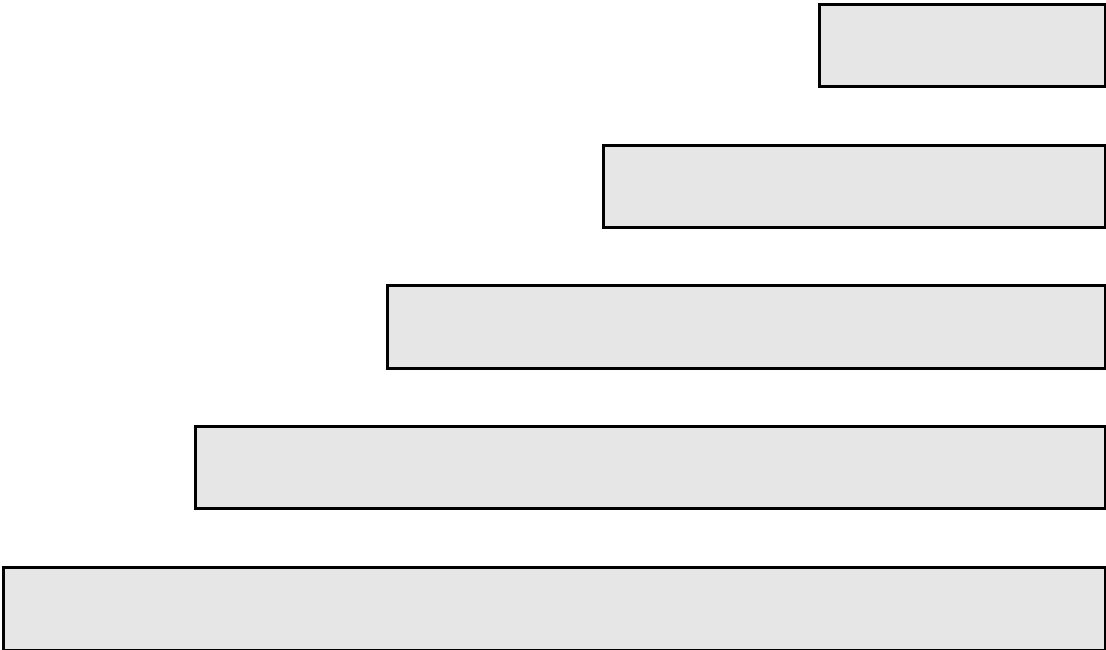
See additional diagrams for pump and piping information.



NORDIC® Series EMW-45-55-65

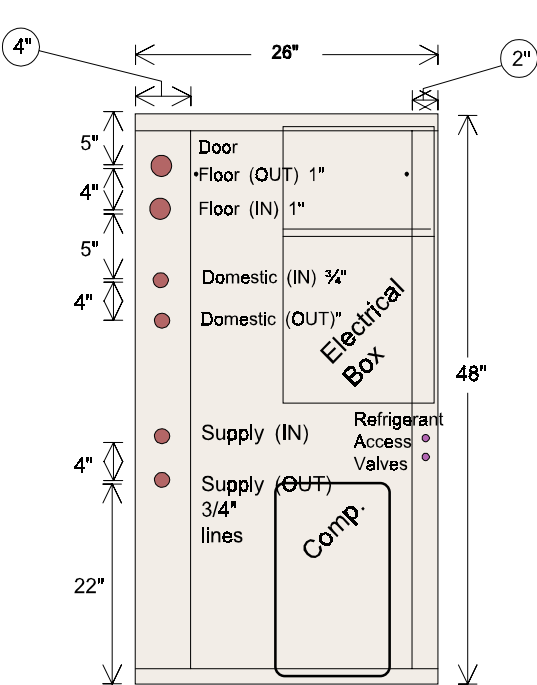


Engineering and Performance Data

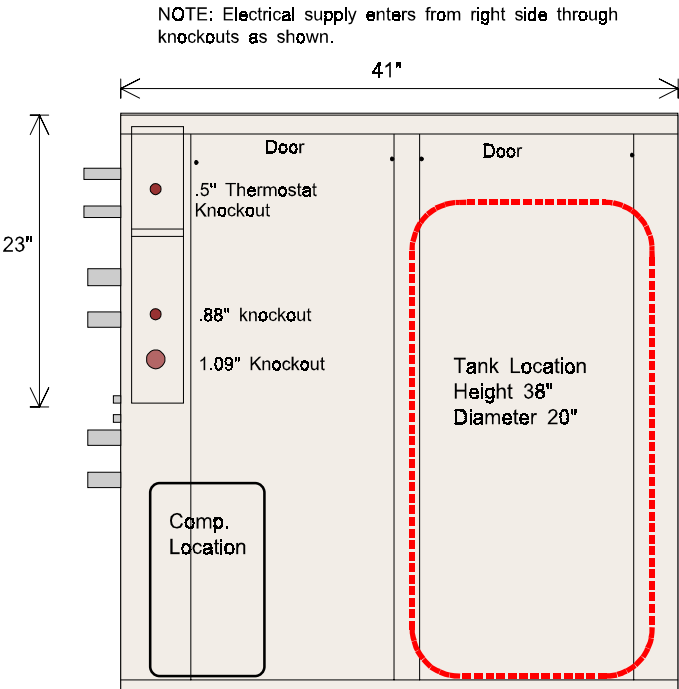


13-Feb-00

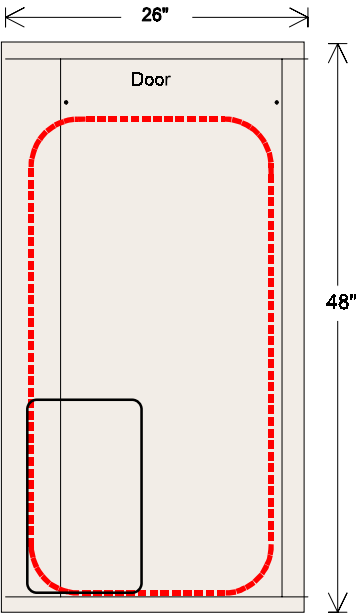
Maritime Geothermal Ltd.		Revision 1.3	Color: Caissie Grey
EMW Series Heat Pumps		Models: EMW-45-65	Style: Vertical
Date: Sunday, February	Drawn By: G.Kaye	Title: Dimensions	



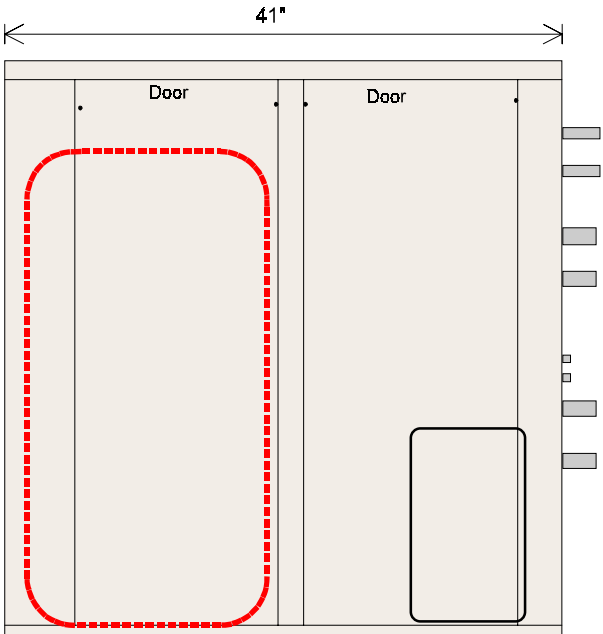
FRONT VIEW



RIGHT SIDE VIEW

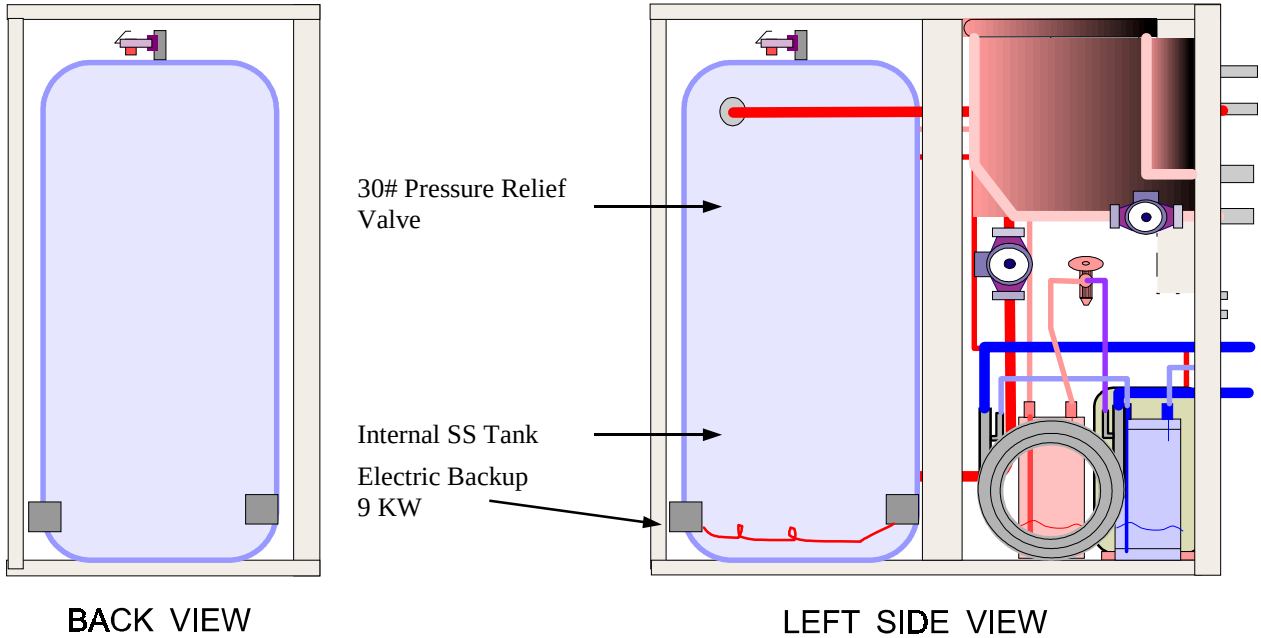
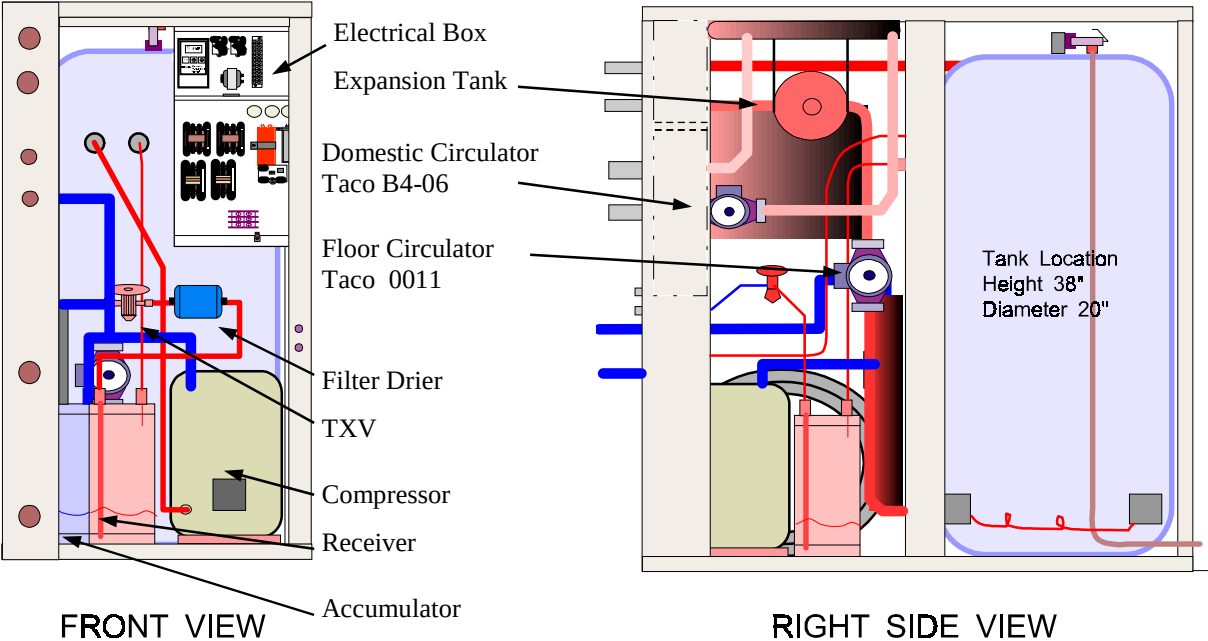


BACK VIEW



RIGHT SIDE VIEW

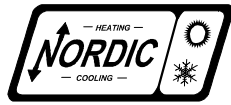
Maritime Geothermal Ltd.		Revision 3.3	Color: Caissie Grey
Energy Module Heat Pumps		Models: EMW-45-65	Style: Vertical
Date: Sunday, February	Drawn By: G.Kaye	Title: Internal Component Layout	



General Specifications:

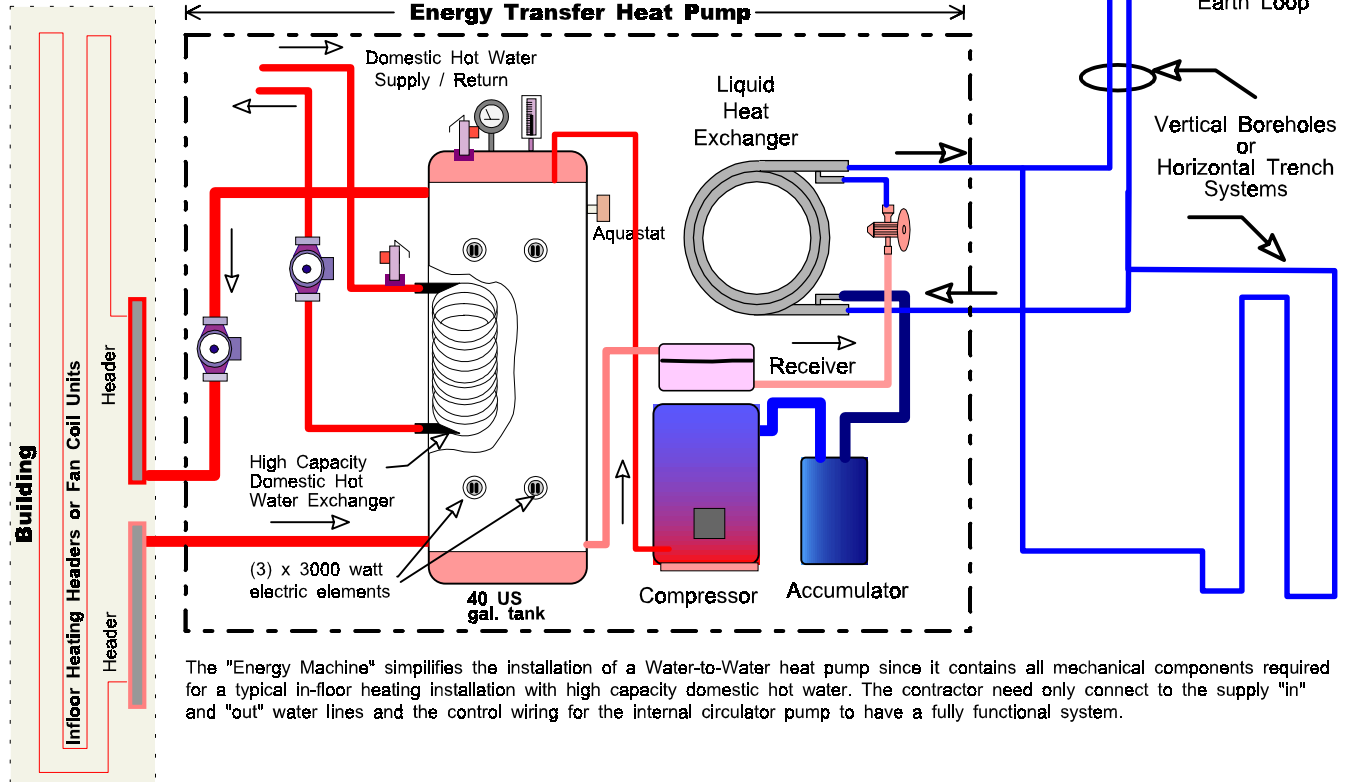
- Satin Galvanized cabinet enclosure.
- 316 SS (40 Igpm) tank.
- Separate domestic hot water heat exchanger.
- Integrated floor circulator pump.
- Integrated expansion tank
- 9 KW back-up electric heat installed.
- 2-stage digital thermostat
- Pressure relief valve.
- Pressure guage & drain valve standard.

Maritime Geothermal Ltd.		Revision 4.0	Color: Caissie Grey
Energy Module Heat Pumps		Models: EMW-45-65	Style: Vertical
Date: Sunday, February	Drawn By: G. Kaye	Title: Component & Piping Layout	



Self Contained Well Water or Groundloop Energy Machine

Energy Receiver



Heat Pump Electrical Service Requirements

Second row lists requirements with 9KW internal back-up heat installed

Model	EMW-45-HW		EMW-55-HW		EMW-65-HW	
Voltage	230/1	208/3	230/1	208/3	230/1	208/3
Min. Circuit Ampacity	21 61 with Elec. back-up	15 50	28 64	20 53	34 70	23 56
Recommended Wire Size	8-3 3-3	10-3 6-3	8-3 3-3	10-3 6-3	6-3 3-3	10-3 6-3
TD Fuse or Breaker	40 70	20 60	40 100	30 60	50 100	30 60
Control Wire	18-3 thermostat wire (for all)					

Performance Specification Sheets**Model EMW-45**

Source						Pres.	Sink				Btu's	Comp.	Comp.		CSA	Suct.	Disch
EWT	Igpm	Lpm	LWT	Diff	HAB	Drop	EWT	LWT	Igpm	Diff	Out	Amps	Watts	COP	COP	Pres.	Pres.
70	14	63.3	65.1	4.9	41,51	4.5	104	111.	12	7.7	55,225	17.5	4018	4.027	3.46	72.1	295
70	12	54.2	64.0	6.0	41,01	3.82	104	111.	12	7.6	54,562	17.3	3970.	3.978	3.50	71.2	292.
70	10	45.2	63	7.2	40,52	2.75	104	111.	12	7.5	53,908	17.2	3922.	3.931	3.53	70.4	289.
60	14	63.3	55.6	4.8	39,30	4.5	104	111.	12	7.3	52,290	17.3	3918	3.910	3.36	69.9	291
60	12	54.2	54.6	5.8	38,83	3.82	104	111.	12	7.2	51,663	17.1	3871.	3.863	3.40	69.1	288.
60	10	45.2	53	7.0	38,36	2.75	104	111.	12	7.1	51,043	17.0	3824.	3.817	3.43	68.3	286.
55	14	63.3	50.4	4.6	37,21	4.5	104	111.	12	7.0	49,512	17.1	3820	3.798	3.27	67.8	288
55	12	54.2	49.4	5.6	36,76	3.82	104	110.	12	6.8	48,917	16.9	3774.	3.752	3.30	67.0	285.
55	10	45.2	48	6.8	36,32	2.75	104	110.	12	6.6	48,330	16.7	3728.	3.707	3.33	66.2	282.
50	14	63.3	45.7	4.5	35,23	4.5	104	110.	12	6.6	46,881	16.7	3680	3.733	3.21	65.0	285
50	12	54.2	44.7	5.5	34,81	3.82	104	110.	12	6.4	46,318	16.5	3635.	3.688	3.24	64.2	281.
50	10	45.2	44	6.6	34,39	2.75	104	110.	12	6.2	45,762	16.5	3592.	3.644	3.27	63.5	279.
45	14	63.3	40.9	4.4	33,36	4.5	104	110.	12	6.4	44,389	16.5	3588	3.625	3.12	63.1	281
45	12	54.2	40.0	5.3	32,96	3.82	104	110.	12	6.2	43,857	16.3	3544.	3.581	3.15	62.3	278.
45	10	45.2	39	6.4	32,56	2.75	104	110.	12	6.0	43,330	16.3	3502.	3.539	3.18	61.6	276.
42	14	63.3	38.1	4.2	31,59	4.5	104	110.	12	6.2	42,030	16.3	3498	3.520	3.03	61.2	278
42	12	54.2	37.2	5.1	31,21	3.82	104	110.	12	6.0	41,526	16.2	3456.	3.478	3.06	60.4	275.
42	10	45.2	36	6.2	30,83	2.75	104	109.	12	5.9	41,028	16.2	3414.	3.436	3.09	59.7	272.
40	14	63.3	35.8	4.1	29,91	4.5	104	110.	12	6.0	39,797	16.1	3411	3.419	2.94	59.3	274
40	12	54.2	34.9	5.0	29,55	3.82	104	109.	12	5.9	39,319	16.0	3369.	3.378	2.97	58.6	271.
40	10	45.2	34	6.0	29,20	2.75	104	109.	12	5.7	38,848	16.0	3329.	3.337	3.00	57.9	269.

Operational figures below are obtained with a 15% solution of methanol (closed loop penalty)

38	14	63.3	33.3	4.8	28,324	4.5	104	109.8	12	5.8	37,682	15.9	3286	3.360	3.06	57.6	271
38	12	54.2	32.3	5.8	27,984	3.82	104	109.6	12	5.6	37,230	15.8	3246	3.320	3.10	56.9	268.7
38	10	45.2	31	7.1	27,648	2.75	104	109.5	12	5.5	36,783	15.8	3207	3.280	3.14	56.2	266.2
36	14	63.3	31.4	4.7	26,819	4.5	104	109.7	12	5.7	36,552	15.7	3203	3.343	3.04	55.8	268
36	12	54.2	30.4	5.7	26,497	3.82	104	109.6	12	5.6	36,113	15.6	3165	3.303	3.08	55.2	265.4
36	10	45.2	29	6.9	26,179	2.75	104	109.4	12	5.4	35,680	15.6	3127	3.263	3.13	54.5	263.0
34	14	63.3	29.5	4.5	25,394	4.5	104	109.7	12	5.7	35,455	15.5	3123	3.326	3.03	54.2	265
34	12	54.2	28.5	5.5	25,089	3.82	104	109.5	12	5.5	35,030	15.4	3086	3.286	3.07	53.5	262.2
34	10	45.2	27	6.7	24,788	2.75	104	109.3	12	5.3	34,609	15.4	3049	3.247	3.11	52.9	259.9
32	14	63.3	27.4	4.4	24,044	4.5	104	109.6	12	5.6	34,391	15.3	3045	3.309	3.01	52.5	261
32	12	54.2	26.5	5.3	23,756	3.82	104	109.4	12	5.4	33,979	15.2	3009	3.269	3.05	51.9	259.1
32	10	45.2	25	6.5	23,471	2.75	104	109.3	12	5.3	33,571	15.2	2973	3.230	3.10	51.3	256.8
30	14	63.3	25.2	4.3	22,766	4.5	104	109.5	12	5.5	33,360	15.2	2969	3.292	3.00	51.0	258
30	12	54.2	24.3	5.2	22,493	3.82	104	109.4	12	5.4	32,959	15.0	2933	3.253	3.04	50.3	256.0
30	10	45.2	23	6.3	22,223	2.75	104	109.2	12	5.2	32,564	15.0	2898	3.213	3.08	49.7	253.7

Tested in accordance with ARI 325 & ARI 330 standards & CAN/CSA C446-M94

Performance Specification Sheets**Model EMW-55**

Source						Pres.	Sink				Btu's	Comp.	Comp.		CSA	Suct.	Disch
EWT	Igpm	Lpm	LWT	Diff	HAB	Drop	EWT	LWT	Igpm	Diff	Out	Amps	Watts	COP	COP	Pres.	Pres.
70	14	63.3	64.2	5.8	49,05	4.5	104	113.	12	9.1	65,510	21.0	4821	3.981	3.42	68.0	305
70	12	54.2	62.9	7.1	48,41	3.82	104	113.	12	9.0	64,658	20.8	4758.	3.930	3.46	67.1	302
70	10	45.2	61	8.6	47,78	2.75	104	112.	12	8.9	63,818	20.6	4696.	3.879	3.49	66.2	300
60	14	63.3	54.7	5.7	46,35	4.5	104	112.	12	8.6	61,903	20.7	4700	3.859	3.32	66.0	301
60	12	54.2	53.5	6.9	45,75	3.82	104	112.	12	8.5	61,099	20.5	4639.	3.809	3.35	65.1	298
60	10	45.2	52	8.3	45,15	2.75	104	112.	12	8.4	60,304	20.3	4579.	3.759	3.39	64.3	296
55	14	63.3	49.5	5.5	43,80	4.5	104	112.	12	8.3	58,495	20.4	4583	3.740	3.22	64.0	297
55	12	54.2	48.4	6.6	43,23	3.82	104	112.	12	8.1	57,735	20.2	4523.	3.691	3.25	63.1	294
55	10	45.2	47	8.0	42,67	2.75	104	111.	12	7.8	56,984	20.1	4464.	3.643	3.28	62.3	292
50	14	63.3	44.9	5.3	41,39	4.5	104	111.	12	7.8	55,275	20.0	4410	3.672	3.16	61.3	293
50	12	54.2	43.8	6.4	40,85	3.82	104	111.	12	7.6	54,556	19.8	4352.	3.624	3.19	60.5	291
50	10	45.2	42	7.8	40,32	2.75	104	111.	12	7.4	53,847	19.8	4296.	3.577	3.22	59.7	288
45	14	63.3	40.1	5.2	39,11	4.5	104	111.	12	7.6	52,231	19.7	4300	3.559	3.06	59.4	289
45	12	54.2	39.0	6.3	38,60	3.82	104	111.	12	7.4	51,552	19.5	4244.	3.513	3.09	58.6	287
45	10	45.2	38	7.6	38,10	2.75	104	111.	12	7.2	50,882	19.5	4188.	3.467	3.12	57.9	284
42	14	63.3	37.3	5.0	36,95	4.5	104	111.	12	7.4	49,356	19.5	4193	3.449	2.97	57.6	286
42	12	54.2	36.2	6.1	36,47	3.82	104	111.	12	7.2	48,714	19.3	4138.	3.404	3.00	56.9	283
42	10	45.2	35	7.3	36,00	2.75	104	110.	12	6.9	48,081	19.3	4084.	3.360	3.03	56.1	281
40	14	63.3	35.0	4.9	34,92	4.5	104	111.	12	7.2	46,638	19.2	4088	3.343	2.87	55.9	282
40	12	54.2	34.0	5.9	34,47	3.82	104	110.	12	6.9	46,032	19.0	4034.	3.299	2.90	55.2	279
40	10	45.2	33	7.1	34,02	2.75	104	110.	12	6.7	45,434	19.0	3982.	3.257	2.93	54.5	277

Operational figures below are obtained with a 15% solution of methanol (closed loop penalty)

38	14	63.3	32.4	5.7	33,00	4.50	104	110.	12	6.9	44,071	19.0	3934	3.283	3.09	54.2	278
38	12	54.2	31.2	6.9	32,57	3.82	104	110.	12	6.7	43,498	18.8	3882.	3.240	3.13	53.5	276
38	10	45.2	29.7	8.4	32,14	2.75	104	110.	12	6.5	42,932	18.8	3832.	3.198	3.18	52.8	273
36	14	63.3	30.6	5.5	31,18	4.50	104	110.	12	6.8	42,749	18.7	3835	3.266	3.07	52.6	275
36	12	54.2	29.4	6.7	30,77	3.82	104	110.	12	6.6	42,193	18.5	3785.	3.223	3.12	51.9	272
36	10	45.2	28.0	8.1	30,37	2.75	104	110.	12	6.4	41,644	18.5	3736.	3.181	3.16	51.2	270
34	14	63.3	28.6	5.4	29,46	4.50	104	110.	12	6.7	41,466	18.5	3739	3.249	3.05	51.0	271
34	12	54.2	27.5	6.5	29,08	3.82	104	110.	12	6.5	40,927	18.3	3690.	3.207	3.10	50.4	269
34	10	45.2	26.1	7.9	28,70	2.75	104	110.	12	6.3	40,395	18.3	3642.	3.165	3.15	49.7	266
32	14	63.3	26.6	5.2	27,84	4.50	104	110.	12	6.6	40,222	18.2	3646	3.232	3.04	49.5	268
32	12	54.2	25.5	6.3	27,48	3.82	104	110.	12	6.4	39,699	18.1	3598.	3.190	3.08	48.8	265
32	10	45.2	24.2	7.6	27,12	2.75	104	110.	12	6.2	39,183	18.1	3551.	3.149	3.13	48.2	263
30	14	63.3	24.4	5.1	26,31	4.50	104	110.	12	6.5	39,015	18.0	3555	3.216	3.02	48.0	264
30	12	54.2	23.4	6.1	25,97	3.82	104	110.	12	6.3	38,508	17.8	3508.	3.174	3.07	47.4	262
30	10	45.2	22.1	7.4	25,63	2.75	104	110.	12	6.1	38,008	17.8	3463.	3.133	3.11	46.8	259

Tested in accordance with ARI 325 & ARI 330 standards & CAN/CSA C446-M94

Performance Specification Sheets**Model EMW-65**

Source						Pres.	Sink				Btu's	Comp.	Comp.		CSA	Suct.	Disch
EWT	Igpm	Lpm	LWT	Diff	HAB	Drop	EWT	LWT	Igpm	Diff	Out	Amps	Watts	COP	COP	Pres.	Pres.
70	14	63.3	63.1	6.9	58,00	4.5	104	114.	12	10.8	78,000	24.4	5860	3.900	3.43	67.0	315
70	12	54.2	61.6	8.4	57,24	3.82	104	114.	12	10.7	76,986	24.2	5783.	3.849	3.48	66.1	312
70	10	45.2	60	10.	56,50	2.75	104	114.	12	10.6	75,985	24.0	5708.	3.799	3.54	65.3	309
60	14	63.3	53.7	6.7	54,80	4.5	104	114.	12	10.2	73,706	24.1	5713	3.780	3.33	65.0	311
60	12	54.2	52.3	8.1	54,09	3.82	104	114.	12	10.1	72,747	23.9	5639.	3.731	3.38	64.1	308
60	10	45.2	51	9.8	53,39	2.75	104	114.	12	10.0	71,802	23.7	5565.	3.682	3.43	63.3	305
55	14	63.3	48.5	6.5	51,78	4.5	104	113.	12	9.9	69,648	23.8	5571	3.663	3.22	63.0	307
55	12	54.2	47.1	7.9	51,11	3.82	104	113.	12	9.6	68,742	23.6	5498.	3.616	3.27	62.2	304
55	10	45.2	45	9.5	50,45	2.75	104	113.	12	9.3	67,849	23.4	5426.	3.569	3.32	61.4	301
50	14	63.3	43.9	6.3	48,93	4.5	104	113.	12	9.3	65,813	23.3	5431	3.550	3.12	60.4	303
50	12	54.2	42.6	7.6	48,30	3.82	104	113.	12	9.1	64,958	23.1	5360.	3.504	3.17	59.6	300
50	10	45.2	41	9.2	47,67	2.75	104	112.	12	8.8	64,113	23.1	5291.	3.459	3.22	58.8	297
45	14	63.3	39.2	6.1	46,24	4.5	104	113.	12	9.1	62,190	23.0	5296	3.441	3.03	58.5	299
45	12	54.2	37.9	7.4	45,64	3.82	104	112.	12	8.8	61,381	22.8	5226.	3.396	3.07	57.8	296
45	10	45.2	36	8.9	45,04	2.75	104	112.	12	8.5	60,583	22.8	5158.	3.352	3.12	57.0	294
42	14	63.3	36.4	5.9	43,69	4.5	104	112.	12	8.8	58,766	22.7	5163	3.335	2.93	56.8	295
42	12	54.2	35.1	7.2	43,13	3.82	104	112.	12	8.5	58,002	22.5	5096.	3.291	2.98	56.0	292
42	10	45.2	34	8.7	42,56	2.75	104	112.	12	8.3	57,248	22.5	5029.	3.249	3.02	55.3	290
40	14	63.3	34.1	5.8	41,29	4.5	104	112.	12	8.5	55,530	22.4	5034	3.232	2.84	55.1	291
40	12	54.2	32.9	7.0	40,75	3.82	104	112.	12	8.3	54,809	22.2	4968.	3.190	2.89	54.4	289
40	10	45.2	31	8.4	40,22	2.75	104	112.	12	8.0	54,096	22.2	4904.	3.149	2.93	53.7	286

Operational figures below are obtained with a 15% solution of methanol (closed loop penalty)

38	14	63.3	31.3	6.8	39,01	4.50	104	112.	12	8.2	52,473	22.1	4844	3.17	2.98	53.4	287
38	12	54.2	29.9	8.2	38,51	3.82	104	111.	12	7.9	51,791	21.9	4781	3.13	3.03	52.7	285
38	10	45.2	28.2	9.9	38,01	2.75	104	111.	12	7.7	51,118	21.9	4719	3.09	3.07	52.1	282
36	14	63.3	29.6	6.5	36,87	4.50	104	112.	12	8.1	50,899	21.8	4723	3.16	2.97	51.8	284
36	12	54.2	28.2	7.9	36,39	3.82	104	111.	12	7.8	50,237	21.6	4662	3.12	3.01	51.2	281
36	10	45.2	26.5	9.6	35,91	2.75	104	111.	12	7.6	49,584	21.6	4601	3.08	3.06	50.5	279
34	14	63.3	27.6	6.4	34,84	4.50	104	112.	12	8.0	49,372	21.5	4605	3.14	2.95	50.3	280
34	12	54.2	26.3	7.7	34,38	3.82	104	111.	12	7.7	48,730	21.3	4545	3.10	3.00	49.6	277
34	10	45.2	24.7	9.3	33,94	2.75	104	111.	12	7.5	48,097	21.3	4486	3.06	3.04	49.0	275
32	14	63.3	25.6	6.2	32,92	4.50	104	111.	12	7.8	47,891	21.2	4490	3.13	2.94	48.8	276
32	12	54.2	24.3	7.5	32,49	3.82	104	111.	12	7.6	47,268	21.0	4432	3.08	2.98	48.1	274
32	10	45.2	22.8	9.0	32,07	2.75	104	111.	12	7.4	46,654	21.0	4374	3.04	3.03	47.5	271
30	14	63.3	23.5	6.0	31,11	4.50	104	111.	12	7.7	46,454	21.0	4378	3.11	2.92	47.3	273
30	12	54.2	22.3	7.2	30,70	3.82	104	111.	12	7.5	45,850	20.8	4321	3.07	2.97	46.7	270
30	10	45.2	20.8	8.7	30,30	2.75	104	111.	12	7.3	45,254	20.8	4265	3.03	3.01	46.1	268

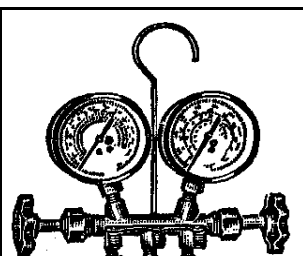
Tested in accordance with ARI 325 & ARI 330 standards & CAN/CSA C446-M94

NORDIC® EMW-Series Trouble Shooting Guide

Fault	Possible Cause	Verification	Recommended Action
<u>COMPRESSOR</u> Compressor not operating	Power Failure	Electric circuit test shows no voltage on the line side of compressor contactor.	Check for blown fuse at heat pump's disconnect box or blown fuse
	Disconnect switch open	Voltmeter shows no voltage on the line side of the compressor contactor.	Determine why the disconnect switch was opened, if all is OK close the switch.
	Fuse blown	At heat pump disconnect box, voltmeter shows voltage on the line side but not on the load side.	Replace fuse with proper size and type. (Time-delay) type "D" Check total load on system.
	Low voltage	Voltmeter shows abnormally low voltage (Below 210 v) at heat pump disconnect switch.	Call power company.
	Burned out motor	Ohmmeter shows no resistance between common and run terminals or between common and start terminals. Note: Be sure compressor overload has had a chance to reset. If comp. is hot this may take several hours.	Determine cause and replace motor.
	Thermal overload on compressor tripped.	Ohmmeter shows reading when placed across R and S terminals and infinity between C & R or C & S. Make sure the internal overload has had time to reset.	If windings are open or overload is faulty, replace compressor.
	Faulty compressor contactor.	Voltage on line side with contactor held closed, but no voltage on one or both terminals on the load side. Points pitted or burned.	Replace contactor.
	Seized compressor due to locked or damaged mechanism.	Compressor attempts to start but trips it's internal overload after a few seconds.	Attempt to "rock" compressor free. If normal operation cannot be established, replace compressor.
	Faulty run capacitor.	Check with ohmmeter for shorts, open etc.	Replace if faulty.

Fault	Possible Cause	Verification	Recommended Action
(cont) Compressor not operating	Open control circuit.	• Thermostat not calling for heat. • High or low pressure limit open. • Lock-out relay energized.	Locate open control and determine cause. Replace faulty control if necessary.
Compressor "short cycles"	Intermittent contact in electrical control circuit.	Normal operation except too frequent starting and stopping.	Check for loose wiring. Check differential setting on aquastat. Widen setting to allow longer run cycles.
	Compressor over-loaded.	Check for continuity through internal overload in compressor.	Observe suction & discharge pressures – make sure amp draw is within range.
<u>HEATING MODE</u> Unit trips off on "LOW" suction pressure control.	Low or no evaporator water flow.	Manually open water valve (if equipped) and measure water flow with a flowmeter.	Check well pump or circ. pump for proper operation. Check water valve for proper operation.
	Evaporator water supply too cold.	Measure temperature of water. Check flow rate with spec. sheet to determine if proper gpm is available.	Increase flow to proper gpm for temperature of water used.
	Faulty low pressure ctrl.	Refrigerant pressure control should open on drop at approx. 45 psig. for well operation and 35 psig. For closed loop application.	The low control should reset automatically when refrigerant pressure reaches 65 to 70 psig. Heat pump can then be restarted by resetting the lock-out relay. (Turn power off then back on) Replace faulty control if it will not reset.
	Low refrigerant charge.	Check water temp. and flow. Clean heat exchanger. If suction is still low check suction gas pres. Normal suction is 50-60 psig. (55 typical) on R-22 or R-407C on a well. Pressure should be 40-45 on a loop during heavy use.	Add refrigerant slowly until sight glass clears. Install fluorescent dye and check for possible leaks with ultra violet light, halide sniffer etc..
Unit trips off on "HIGH" pres. control.	Low or no water in tank. Aquastat set too high. TXV stuck closed. Filter drier plugged.	Make sure tank is full of water. Aquastat should be below 120°F. Check for refrigerant flow through TXV and filter.	Open purge valve on top of tank to make sure it is full of water. Observe and adjust aquastat setting. Replace filter or TXV if required.

Fault	Possible Cause	Verification	Recommended Action
COOLING MODE (OPTIONAL) Low "temperature sensor" opens.	Low or no water level in evaporator tank. (Note: The function of the two heat exchangers are reversed when in cooling mode. Evap. Becomes cond. / cond. Becomes evaporator.)	Check fluid flow, strainers, pumps and valves in the system. Temp. ctrl. will open in about 1 minute if water level is low or if unit is run with suction pressure below 50 psig.	Restore proper level in cold buffer tank. Purge air through relief valve. Reset lock-out relay. Replace low suction temp. thermostat.
	Aquastat on cold buffer tank set too low. Should be 43 – 45° F	Verify accuracy of aquastat with reliable hand held thermometer.	Replace or readjust aquastat for proper operation.
High Pressure limit opens.	Low water flow on condenser side	Check flow of well water or loop water. Check for air or strainer restrictions. Water valves open.	Restore flow and reset lock-out relay.
	TXV possibly not opening. Liquid line possibly plugged.	Warm bulb with hand and observe suction pressure while operating.	Replace TXV or filter-drier if non operational or plugged.
DOMESTIC HOT WATER PREHEAT TANK Insufficient hot water.	Circulator pump not operating.	Use an amprobe to measure current draw.	Replace if faulty.
	Blockage or restriction in the water line or hot water heat exchanger.	Check water flow and power to pump. Check water lines for obstruction	Remove obstruction in water lines. Acid treat the domestic hot water coil.

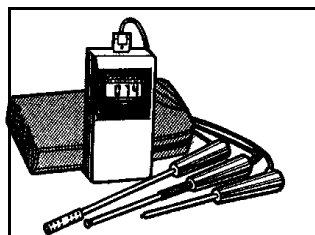


Refrigeration Gauges

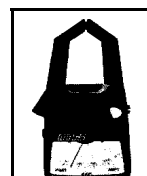


In-line Flowmeter

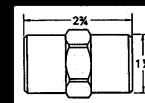
Service Tools



Digital Thermometer



Amp probe



Dole flow control Valve

The Dole® flow control is a simple, self-cleaning device designed to deliver a constant volume of water from any outlet whether the pressure is 15 psig or as high as 125 psi. The controlling mechanism consists of a flexible orifice that varies its area inversely with pressure so that a constant flow is maintained.

Ranco® ETC Thermostat Controls

The Ranco® ETC is a microprocessor-based electronic temperature control designed to handle the OFF/ON functions of the NOR-DIC® EMW unit. The ETC is equipped with an LCD display which provides a constant readout of the sensed temperature and a touch keypad that allows the user to easily and accurately select the setpoint temperatures and differentials for the first and second stages of operation.

Programming Steps and Display

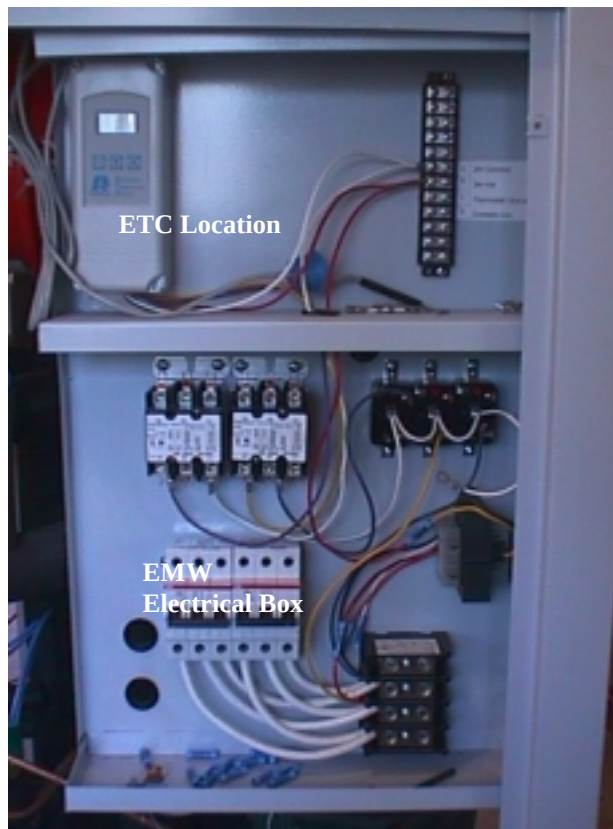
STAGE 1

Step 1– To start programming, press the **SET** key once to access the Fahrenheit/Celsius mode. The display will show the current status, either F for degrees Fahrenheit or C for degrees Celsius. Then press either the **UP** arrow or **DOWN** arrow key to toggle between the F° or C° designation. For closer regulation of your water temperatures we recommend you program in the Fahrenheit mode.

Step 2– Press the **SET** key again to access the stage1 setpoint. The LCD will display the current setpoint and the S1 annunciator will be blinking on and off to indicate that the control is in the setpoint mode. Then press either the **UP** arrow key to increase or the **DOWN** arrow key to decrease the setpoint to the desired temperature.

Step 3– Press the **SET** key again to access the stage1 differential. The LCD will display the current differential and the **Dif 1** annunciator will be blinking on and off to indicate that the control is in the differential mode. Then press either the **UP** arrow key to increase or the **DOWN** arrow key to decrease the differential to the desired setting.

Step 4– Press the **SET** key again to access the stage1 cooling or heating mode. The LCD will display the current mode, ei-



ther **C1** for cooling or **H1** for heating. Then press the **UP** or **DOWN** key to toggle between the **C1** or **H1** designation.

STAGE 2

Step 5– Press the **SET** key again to access the stage 2 setpoint. The LCD will display the current setpoint and the **S2** annunciator will be blinking on and off to indicate the control is in the setpoint mode. Then press either the **UP** key to increase or the **DOWN** key to decrease the setpoint to the desired temperature.

Step 6– Press the **SET** key again to access the stage2 differential. The LCD will display the current differential and the **DIF 2** annunciator will be blinking on and off to indicate that the control is in the differential mode. Then press either the **UP** arrow key to increase or the **DOWN** arrow key to decrease the differential to the desired setting.

Step 7– Press the **SET** key again to access the stage 2 cooling or heating mode. The LCD will display the current mode, either **C2** for cooling or **H2** for heating. Then press either the up or down key to toggle between the **C2** and **H2** designation. Press the **SET** key once more and programming is complete.

NOTE: The ETC will automatically end programming if no keys are depressed for a period of 30 seconds. Any settings that have been input to the control will be accepted at that point.

All control settings are retained in non-volatile memory if power to ETC is interrupted for

any reason. Re-programming is not necessary after power outages or disconnects unless different control settings are required.

Ranco® ETC Thermostats

Cover screws (4)

Circuit board

Mounting Holes

Conduit Opening



8 ft. extension cable

Temperature sensor

Locking switch

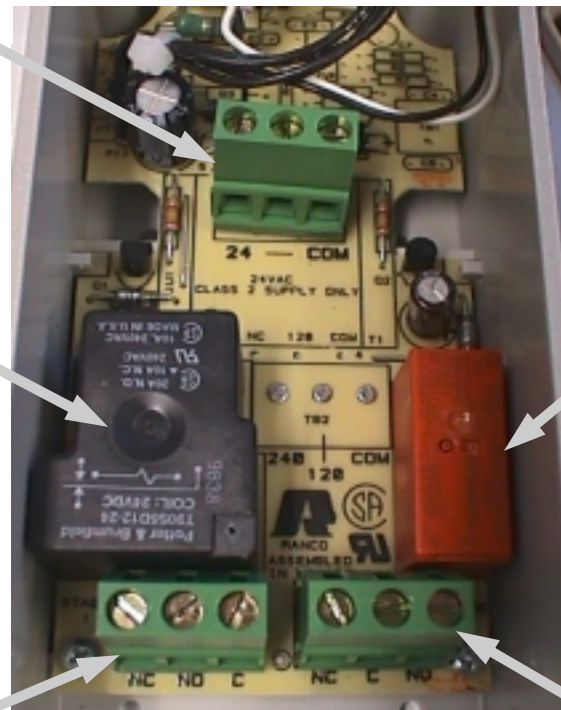
Shown Below

NOTE:

The temperature "sensor" can be extended up to 400 ft. by cutting the sensor extension cable and splicing 22 gauge (2 conductor) copper wire in place. Regular telephone wire can be used for this operation.

24v Power Connection

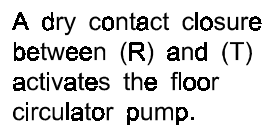
Stage 1 relay

Stage 1
NC NO C

Stage 2 relay

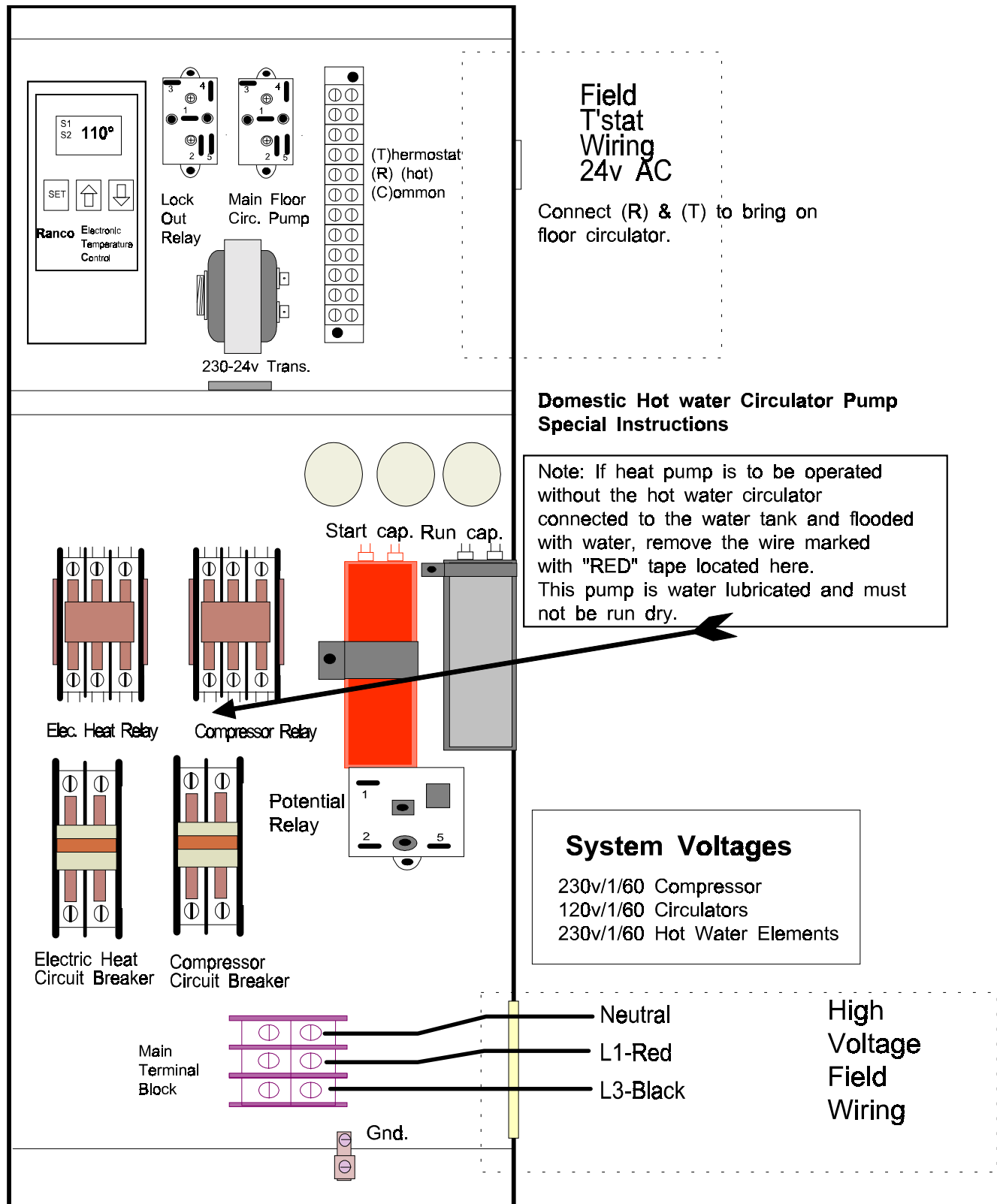
Stage 2
NC C NO

230/1/60 Schematic Diagram



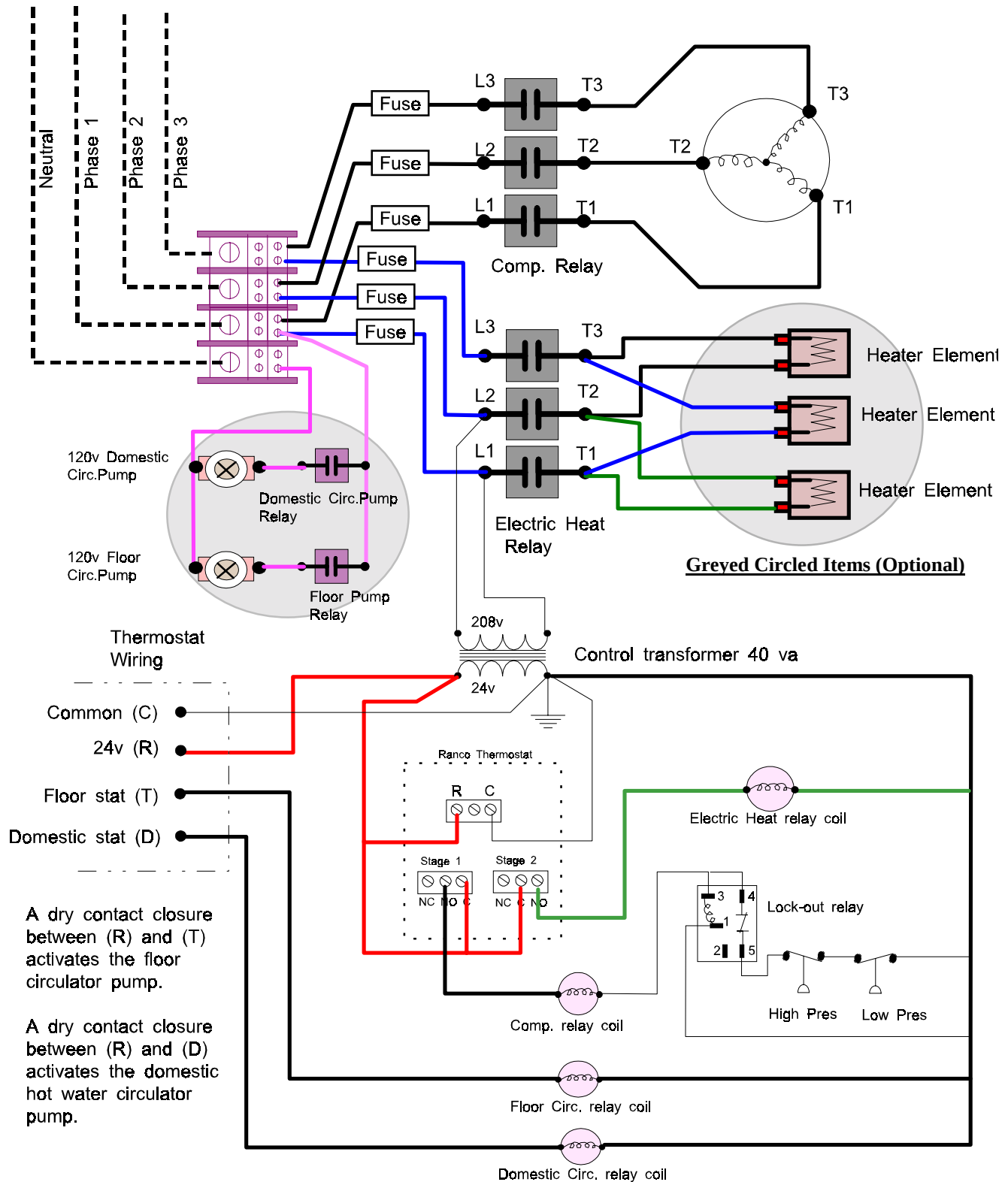
NORDIC® EMW-HW Series Electrical Box

230v/1/60 Box – Heating & Domestic Hot Water Versions



NORDIC® EMW-45-55-65-HW Series - Schematic

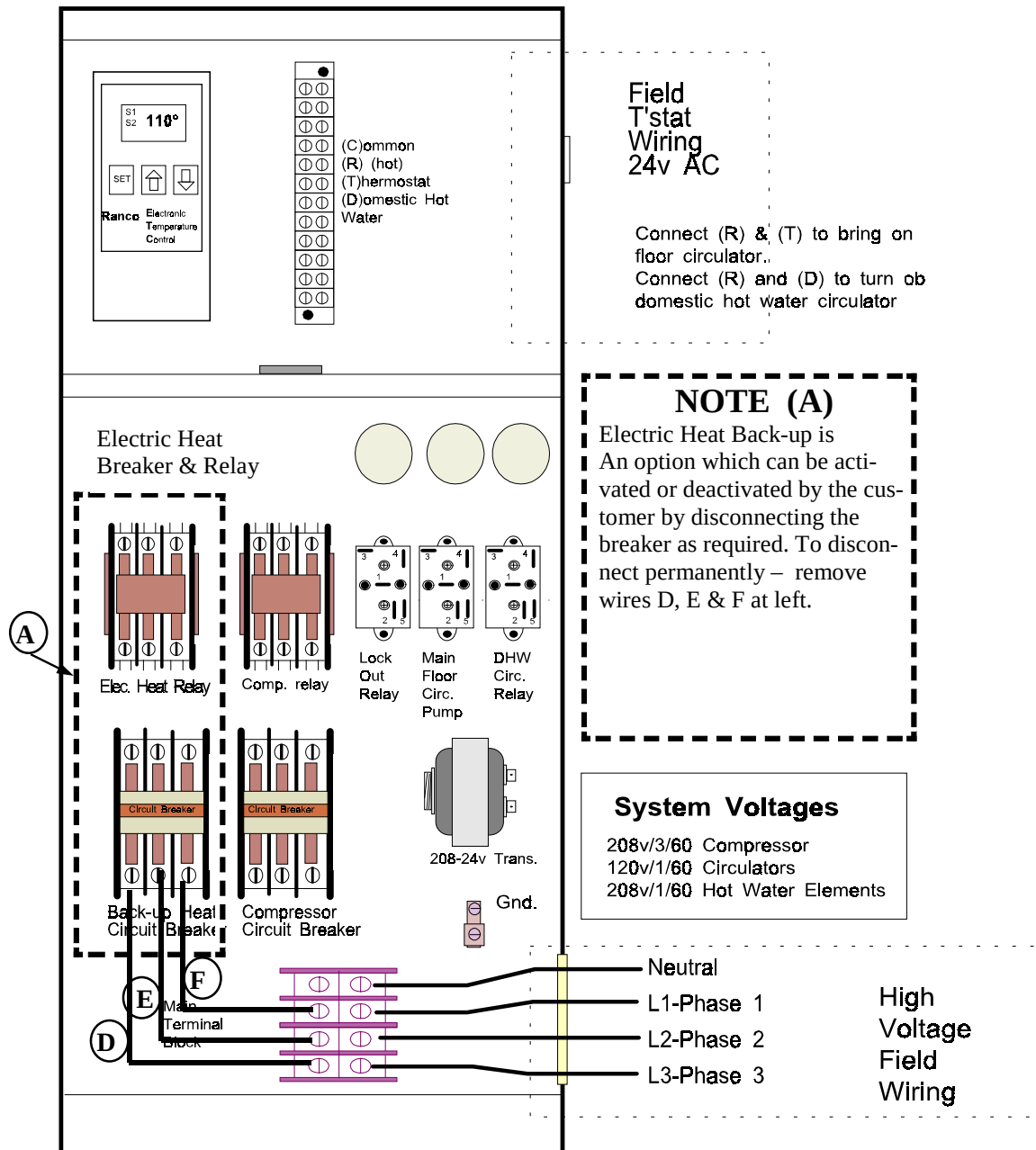
208v/3ph/60Hz



NORDIC® EMW-HW Series Electrical Box

208v/3/60 Box – Heating & Domestic Hot Water Versions

Maritime Geothermal Ltd. - EM-Series Heat Pumps Electrical Box Connection Diagram



L I M I T E D W A R R A N T Y

MARITIME GEOTHERMAL LTD. warrants that the heat pumps manufactured by it shall be free from defects in materials and workmanship for a period of (1) ONE YEAR after the date of installation or for a period of (1) ONE YEAR AND (60) SIXTY DAYS after the date of shipment, whichever occurs first. In addition MARITIME GEOTHERMAL LTD. warrants that the compressor shall be free of defects in materials and workmanship for an additional period of (48) FORTY-EIGHT MONTHS from said date.

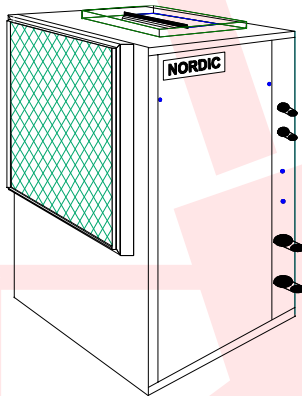
MARITIME GEOTHERMAL LTD. shall, at it's option repair or replace any part or parts covered by this warranty which shall be returned to MARITIME GEOTHERMAL LTD., transportation charges prepaid, which, upon examination proves to be defective in materials or workmanship. Replacement or repaired parts and components are warranted only for the remaining portion of the original warranty period.

This warranty is subject to the following conditions:

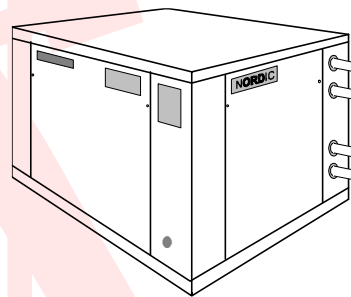
1. The NORDIC® heat pump must be properly installed and maintained in accordance with MARITIME Geothermal LTD.'s installation and maintenance instructions.
2. The installer must complete the “**Installation Data Sheet**”, have it endorsed by the owner and return it to Maritime Geothermal Ltd. within 21 days after the installation of the unit.
3. It is the responsibility of the building or general contractor to supply temporary heat to the structure prior to occupancy. These heat pumps are designed to provide heat only to the completely finished and insulated structure. Start-up of the unit shall not be scheduled prior to completion of construction and final duct installation for validation of this warranty.

If the heat pump, manufactured by MARITIME GEOTHERMAL LTD. fails to conform to this warranty, MARITIME GEOTHERMAL LTD. 's sole and exclusive liability shall be, at it's option, to repair or replace any part or component which is returned by the customer during the applicable warranty period set forth above, provided that (1) MARITIME Geothermal LTD. is promptly notified in writing upon discovery by the customer that such part or component fails to conform to this warranty. (2) The customer returns such part or component to MARITIME GEOTHERMAL LTD., transportation charges prepaid, within (30) thirty days of failure, and (3) MARITIME GEOTHERMAL LTD. 's examination of such component shall disclose to it's satisfaction that such part or component fails to meet this warranty and the alleged defects were not caused by accident, misuse, neglect, alteration, improper installation, repair or improper testing.

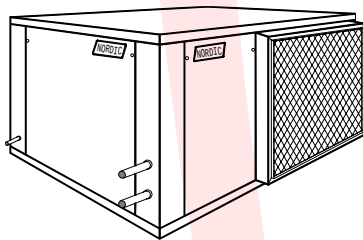
Maritime Geothermal Ltd.
has the solution for all your
heating and cooling projects



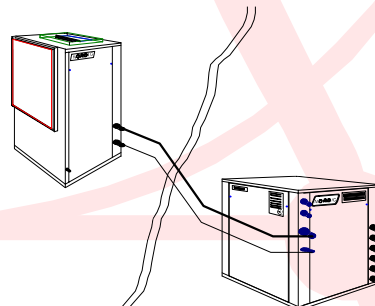
**Vertical
Liquid-to-Air**



Liquid-to-Liquid



**Horizontal Slim
Liquid-to-Air**



Split Systems

**NORDIC® – Environmentally sound solutions to
today's Heating and Cooling needs.**

